THE

ELECTRICAL REVIEW.

VOL. LVIII. MARCH 23, 1906. No. 1,478.

ELECTRICAL REVIEW.

Vol. LVIII.] CONTENTS: March 23, 1906. [No. 1,478.

	Page
Telephone Rates	453
The Lighting of Shops and Shop Windows	454
Unipolar Machines as Single-Phase Motors (*illus.*)	456
Blast Furnace Gas and Electrolytic Work	457
A New Method of Casting Copper (*illus.*)	457
Correspondence	457
Legal	461
Parliamentary	462
Business Notes	462
Wireless Telegraphy in German South-West Africa (*illus.*)	473
The Shawinigan Water and Power Co. (*illus.*)	474
City Notes	478
Market Quotations	484
Stocks and Shares	484
Share List of Electrical Companies	485
The Keeping of Consumers' Records in Electric Supply Undertakings (*illus.*)	487
The Royal College of Science	488
Books	489
Proceedings of Institutions:—	
Available Power and Cost of Operation of a Power Station for Waste Gases from a Blast Furnace Plant	490
Notes on the Construction and Maintenance of Overhead Equipment (Discussion)	491
Physical Society	492
The Maintenance of Underground Mains (Discussion)	493
The Neutral Markets of the World: their Opportunities	493
Electric Railways in Germany	494
The Draughtsman	495
New Patents Applied For	496
Electrical Patents Expiring in 1906	496
Published Specifications	496

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone No. 933 Holborn; 4425 Central.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free, per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

1906 Edition

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

TELEPHONE RATES.

THE control of the telephone system by the Post Office brings it, of course, within the sphere of influence of that celebrated Postal reformer and candid critic, Mr. Henniker Heaton, who has given notice of a question in Parliament, asking Mr. Sydney Buxton whether his attention has been called to a speech of the Australian Postmaster-General, wherein he expressed the conviction that he would be able "to give every man in that country a telephone in his own house at the cost of one shilling a week." Mr. Heaton intends further to ask whether Mr. Sydney Buxton would consider the question of reducing the telephone charges in this country. The publication of this question on the 14th inst. was followed by an interview with Mr. Heaton by a representative of the *Standard*, which appeared on the 15th. Assuming the authenticity of the interview, we may say that the expression of the Australian Postmaster-General's belief of what he will be able to do, as cited in the question, becomes a "promise" in the interview. The Australian householder has been promised a telephone for a shilling a week. "Why, then, should not similar benefits be conferred on the people of this country?" England has the most expensive and the worst telephone system, he declared. No other country is so badly served. Norway and Sweden do duty over again in the way that all telephone readers will remember, Australia is far in advance of us, and on the Continent there is no country where things are not infinitely better managed. The interviewer asked, "'Do you really think that telephones could be profitably supplied for a shilling a week?' 'Why not? Certainly the present rates which are absurdly high could be halved with great advantage, both to the Post Office and to the public,' said Mr. Heaton in a tone of assurance that carried conviction, 'The whole thing has been carefully worked out already; it is merely a question of intelligent and businesslike administration.'"

Unconsciously, perhaps, the *Standard* interviewer strikes the familiar note of the telephone reformer in his reference to the "tone of assurance that carries conviction"—the assurance which is seldom lacking in the uninformed, and the conviction which is readily obtained when there is every inducement to believe in the promises set forth.

We have not before us the speech of the Australian Postmaster-General to which Mr. Henniker Heaton referred, and are thus unable to say whether his remarks have been accurately summarised, but since Mr. Heaton refers to Australia we would suggest that he should study the very able report of Mr. John Hesketh, electrical engineer, Postmaster-General's department, Queensland, which report was presented to the Commonwealth Parliament and ordered by the House to be printed September 8th, 1905. Mr. Hesketh was deputed to make a tour of inspection in the United States and Europe, and his first report is "upon the present position of the telephone art, with suggestions as to the action desirable for the proper development of the telephone

systems of the Commonwealth of Australia." There is included in the report a "draft scheme of charges" which commences with the words "Any revised scheme should, in my opinion, include varying charges for exchanges of different sizes"; he recommends the message rate, and expresses the opinion that with 600 calls per annum free, the following rates would be remunerative under certain conditions, even in the largest Australian centres:—Separate line, £7 per annum; two-party line, £5 per annum; four-party line, £3 10s. per annum. These are the rates considered suitable for the largest centres, such as Sydney or Melbourne, and for smaller towns he thinks that rates as much as 20 or possibly 25 per cent. lower, may be calculated upon. Now, if we take the higher percentage from the lowest quoted rate (25 per cent. from £3 10s.), we obtain £2 12s. 6d., and we have only to throw over the 6d. to arrive at the shilling a week of the Australian Postmaster-General's speech and Mr. Heaton's subsequent Parliamentary question. If, however, we are correct in assuming that Mr. Hesketh's draft figures are the foundation for these Parliamentary utterances, it is necessary to observe that the shilling a week is not applicable to "every man" in that country, but to a subscriber in a second-rate town who shares a line with three other subscribers, and makes something less than two calls per day. Before Mr. Heaton puts his question it might be well for him to make a comparison with similar service here. Let us compare the direct line: for £7 per annum the citizen of Sydney or Melbourne will be able to send 600 calls; in London to-day from either the Post Office or the National Telephone Co. he can obtain a direct line and send 600 calls for £7 10s. per annum. Omitting from consideration the very important question of the respective areas covered, where, on figures alone, is the justification for the statement that English rates are absurdly high and could be halved with great advantage? No one will dispute the advantage to the purchaser of obtaining anything at half price, but telephone service is so valuable to the user that he can well afford to pay all that it costs and something for profit besides. A revision of rates may be desirable with a view to extend the advantages of the telephone service to a larger proportion of the population than at present. All that Mr. Heaton says of the advantages of the service will be readily admitted; but to obtain these advantages it is necessary to avoid any inaccurate inferences and fallacious comparisons. The subject is one requiring the most careful examination by experts with accurate data to guide them, and cannot be handled satisfactorily in the dogmatic way which usually follows a superficial examination. If London and other large cities were divided into sections, each section for free calls being equivalent in size or population to a second-rate Australian town, an initial tariff might be arrived at which would compare favourably with that in force in any other country. Perhaps some such method of "re-distribution" would enable telephone service to be extended as Mr. Henniker Heaton, in common with us all, desires.

THE LIGHTING OF SHOPS AND SHOP WINDOWS.

In the *Central Station*, a New York journal devoted to the interests of lighting and power stations, there is an article by Mr. E. Leavenworth Elliott on the above subject, which contains some hints to those who are responsible for advising on or installing such jobs. As the shop is the most important asset to a supply undertaking, there is nobody who should be more interested in the subject than the station engineer, for whose edification the article is written. The objects to be aimed at are:—(1) To show the goods under the same conditions of illumination as they will be used by the buyer; or (2) to furnish a light for showing them most clearly in detail. House furnishings come under the first category, practically everything else under the second. As regards the form of light, therefore, the incandescent electric lamp is undoubtedly best for house furnishings, whilst for the rest a near approach to daylight should be aimed at. The arc lamp seems naturally to meet the latter case, but the author points out that with the exception for showing off white goods, the arc lamp is generally considered too glaring, and it becomes necessary to filter the light through opaline globes in order to obtain a better diffusion. This lowers the efficiency, which in any case he considers over-estimated. Arc lamps thus equipped are no more efficient than incandescent lamps with good reflectors, except in cases where the ceilings are high, when, of course, the arc lamp is more suitable. But the introduction of special high-efficiency lamps and large bulb lamps with reflectors has caused the enclosed arc to lose its advantage of economy; whilst the former lamps show no colour contrast with ordinary incandescent lamps, and being smaller units, give a better distribution of light. Mr. Elliott considers units of from 40 to 100 c.p. the happy medium for lighting. It is often the case that a shop is wired without any reference to the ultimate position of the goods, whereas this could easily be set out before the lighting scheme is settled on. The best position is stated to be nearly above the back edge of the counter, except where there are glass cases, when the sources of light must be inside and quite hidden from the customers' view.

With regard to the shop window, it is laid down that (1) all light sources must be concealed, and (2) a light must be provided of sufficient intensity to be distinctly visible above the general illumination surrounding the window. Many shopkeepers entirely ignore these points, no doubt from ignorance, and by showing lines or centres of unshaded lights, they quite defeat the object they have in view, namely, to display their goods to advantage. All they succeed in doing is to waste a lot of light by dazzling the customer. If it be desired to attract the customer, then there are other methods which should be applied outside the window and away from the goods. Of course, the method generally used in this country, and known as Linolite, meets most of the conditions required for window lighting; but there are occasions where special effects are desirable, particularly in the case of deep windows where furniture and hangings are displayed. Here it is that the station engineer can give assistance and advice, and he should be prepared to do this if he does not wish to see the best class of consumers go over to the side of gas.

Statutory Nuisance.

In another column we give an account of an action between the London Hydraulic Power Co. and the St. James' and Pall Mall Electric Light Co., Ltd., from which it appears that all companies possessing statutory powers should seriously consider their position in regard to the question of nuisance. It is usual in Acts and Licences conferring powers for the supply of gas, water, electricity, &c., for there to be some such provision as this:—"Nothing in this Act shall exempt the company from any indictment, action or other proceeding for nuisance in the event of any nuisance being caused by them." It appears from the decision in the above-mentioned case, and from that of the Court of Appeal in Midwood *v.* the Corporation of Manchester, that should the exercise of statutory powers result in a nuisance taking place, the party exercising those powers will be liable in damages even though no negligence can be proved.

It is obvious that this throws a very heavy burden upon electric light companies, as, should any unforeseen accident take place in the neighbourhood of their works, there will be a strong tendency on the part of persons affected to endeavour to prove that such accident has been caused by the electric light system, and that therefore the company owning such system has committed a continuing nuisance. Even if not always successful, such claims would cause considerable loss in time and money to the companies, and we would urge upon them the advisability of keeping their works as far as possible from those of other undertakers, and of maintaining a system of regular inspection, with full records of the condition of such works.

In the case referred to, the London Hydraulic Power Co. were not successful in their action; on the counterclaim, however, the Electricity Co. were successful on the grounds already mentioned, viz., that the Power Co., in losing control of their high pressure water, had committed a nuisance, and were responsible for the damage resulting therefrom, even though they had not been guilty of negligence.

India-Rubber. Statements as to the quantity of cultivated rubber which can be produced per acre of land, made by Dr. Schlich in the *Times* Financial and Commercial Supplement, of March 12th, have drawn a strongly worded protest from Mr. J. Nisbet, formerly Conservator of Forests, Burma, who states that with suitable soil and efficient management, a mature tree of the Hevea braziliensis kind, yields upwards of 5 lb. of dry rubber a year. From this, assuming that each tree occupies 324 sq. ft., being planted 18 ft. apart, the yield per acre comes to 6 cwt., worth something like £200, at 6s. a pound. There seems little doubt that the cultivation of rubber in suitable parts of the Tropics will have a serious effect on the trade of Northern Brazil at no very distant period. Cultivation in that deadly region would be almost impossible except on a small scale. In quality, too, it is only to be expected that properly looked after trees should be more satisfactory than the wild ones growing amid thick jungle and absolutely uncared for.

Wireless Telegraphy. It is interesting to learn from the published yearly report of one of the Wireless Companies that the time required for the erection of a tower, or station, suitable for trans-Atlantic experiments is no less than about one year. Those who think that communication by wireless is the thing for emergencies, when there would be insufficient time for the construction of a submarine cable, should make a note of this. There is no cable manufacturing company that would not undertake to make and lay two Atlantic cables in the time.

German Submarine Cables. We learn from the *Electrical World*, New York, of March 10th, that a very interesting review has been presented by U.S. Consul Liefield, of Freiburg, Germany, on the development of the German submarine cable system, in which attention is called to the significance of the fact that the new cable from Yap to Shanghai furnishes the final link in the first non-British cable to encircle the globe. We cannot quite follow that statement, but it is instructive to note that the Consul of the United States is alive to the importance of letting his country know what is going on abroad. Have we Consuls in Germany?

Limitations. A short article under the title of "Tendencies in Power Plant Design" in the current issue of *Cassier's Magazine*, by Mr. G. L. Clark, serves rather to enumerate a number of features than to speak of the limits to certain tendencies. But to speak of limitations in any branch of engineering requires a man bold either through ignorance or through knowledge. Limits there must be, but one's sense of limitation is an expanding subject, and what was physically impossible a decade ago in many spheres, is to-day commonplace. Most of our ideas are restricted by ignorance as to what the metallurgist will be next able to offer us. For instance, generating sets in large power houses show us signs of having reached their maximum in point of output. As Mr. Clark points out:—"Given a 2,250-H.P. electric locomotive, like the New York Central Railroad Co.'s type, taking 3,000 H.P. on overloads, and capable of being operated with others of the same size in trains on the multiple-unit system of control, it is evident that the power house units to supply a single division must be mammoth machines if the operating simplicity of the generating plant is to be retained. The same kind of reasoning applies equally well to the alternating current locomotive's demands upon the generating system." At this point Mr. Clark stops in regard to this subject. One would like to hear an Institution discussion on the limits in this direction alone, and to be so far-sighted as to be able to contrast mentally the sense of to-day's limitations with the achievements of ten years hence. So far as direct-coupled reciprocating sets are concerned, the marine engine builder can give us more powerful engines than those yet in our central stations, for which larger dynamos or alternators could be designed.

What, after all, are some of the limits? Chiefly the strength of the materials available, and partly the question of the size which can be dealt with in the forge, foundry, or machine shop. Physical and mechanical difficulties alike confront us. Critical velocities, centrifugal forces, and the effect of temperature on the materials we use, all call, as do other factors, for consideration.

For the foundations of further progress we must look chiefly to the metallurgist. Ferro-alloys increase in numbers, and more largely in their range of strength, and the engine builder's choice of material and possible scope of output are far wider than was possible a decade ago.

The dynamo designer dreams of an alloy surpassing in permeability the best soft iron of to-day, and looks to the metallurgist to provide it. He would also like to dream—but hesitates to do so in his waking moments—of a conductor which, bulk for bulk and weight for weight, would be superior to electrolytic copper. Given these, the progress in electrical engineering would be at a rate which would put in the shade past performances, brilliant though these have been.

Mr. Clark, on the subject of present tendencies, has refrained from speculation as to size limits in generating sets, and we have attempted to supply reasons for this deficiency. Of other subjects he chronicles the increase of labour-saving methods in reducing the power plant attendant's manual work. Speaking of the efficiency of production, he urges that the field for future activities will be on the mechanical side: "The battle between the reciprocating engine, the steam turbine, and the gas engine shows little sign of abating, but the field of each machine is becoming better defined. It is impossible to predict the outcome of this competition of motive power as long as the cost of coal does not greatly advance; but in the distant future it is highly probable that the internal combustion engine, using alcohol as a fuel, will attain a development of huge proportions. Power-station design is largely determined by the type of prime mover employed, and the available supply of fuel has a vital bearing upon the whole subject."

In regard to all these, there are certain limitations. We should like to ask what they definitely are? There would remain the possibility for the future as for the past, that an answer defining the limits of the ideals of to-day would yet outline the commonplace achievements of the utilitarian to-morrow, whose sons would dream wider dreams and see more splendid visions than are in our ken.

UNIPOLAR MACHINES AS SINGLE-PHASE MOTORS.

The improvements in unipolar machines recently introduced by the General Electric Co., U.S.A., under Noeggerath's patents, make the question of the use of these machines as single-phase motors of some interest, and Herr Huppers deals with

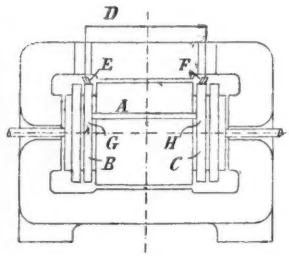


Fig. 1.

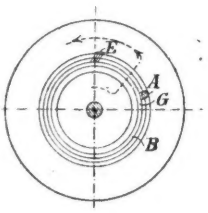


Fig. 2.

the subject in a short article in *Elektrotechnik und Maschinenbau*. Fig. 1 represents such a machine with conductors A, slip rings B and C, brushes E and F, and the return connection D forming the current path. The armature reaction in such a machine will be of primary importance and will decide whether it is practicable or not. An actual cross field due to the circuit formed by the conductor G H, the parts of the slip rings lying between G and E and between H and F, and the return conductor D, such as is shown by the dotted arrow in fig. 2, cannot be set up because, if used on an alternating circuit, all the iron of the machine will have to be laminated axially, and the laminations will, therefore, be in a position to prevent such a flux being set up. The only direction in which flux can be set up is the direction of the main flux, so that the rotor currents will act simply as back ampere-turns. When the current from a rotor conductor reaches the slip ring it divides into two

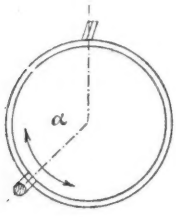


Fig. 3.

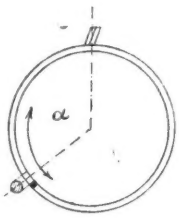


Fig. 4.

parts (fig. 3), and these two parts are proportional to the angle α and the angle $(2\pi - \alpha)$ respectively. These two currents pass round the ring in opposite directions, and so neutralise one another as far as actual weakening of the main flux is concerned, although they produce distortion of the main flux. This distortion can be prevented in the way described by Noeggerath. If the rotor is to react inductively on the stator, it is essential that the rotor shall be in a position to produce actual variations in the main flux. By opening the slip rings at one point, as shown in fig. 4, and connecting the conductor at one side of this gap, the current only flows towards the brush in one direction round the ring, so that the neutralising action of the two sides of the ring is prevented. The periphery enclosed by such a rotor turn varies regularly from 0 to 2π, and then suddenly to 0 again, so that by employing a sufficient number of conductors and rings the product of turns by periphery enclosed may be considered as practically constant.

Leakage fluxes occur in both the rotor and the stator, though in the former they can be prevented by a compensating winding. To sum up, it may be taken that no cross fields will exist in the unipolar machine, and that back ampere-turns may, or may not, be present according to the construction adopted.

The unipolar machine, like the ordinary multipolar one, may be arranged with direct supply of energy to the rotor (series motor), or with only inductive connection between stator and rotor (induction motor). The characteristics of the compensated or uncompensated unipolar series motor are similar to those of the corresponding multipolar one, the starting conditions for a compensated motor being represented by fig. 5, where e is the supply voltage, E_s is the stator back voltage, which, when added vectorially to the rotor and stator resistance drop l, has to equal the supply

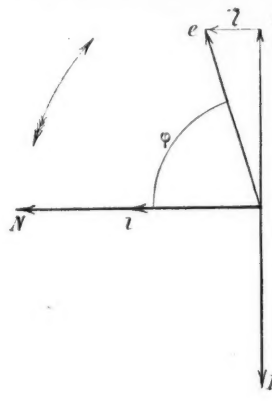


Fig. 5.

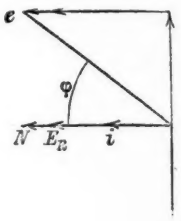


Fig. 6.

voltage e. N is the main flux, and i the input current. When running, an additional E.M.F. of rotation E_R (fig. 6) is present in phase with the flux N.

When the unipolar machine is to be used as an induction motor, the rotor cannot be compensated, for an inductive action between rotor and stator is essential. At the same time, the rotor cannot be a short-circuited one, as the currents in half the conductors would oppose those in the other half, and no torque would be produced. The rotor must have slip-rings, and these must be split at one point, as shown in fig. 4. The vector diagram for such a motor when running is shown in fig. 7, where e is the supply

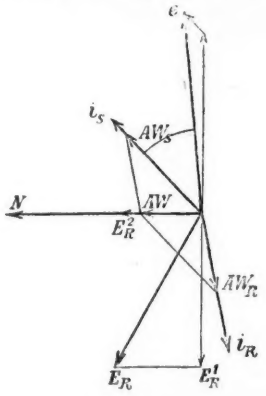


Fig. 7.

voltage, E_R^1 the voltage induced in the rotor by transformer action, N is the main flux, and E_R^2 is a voltage set up in the rotor by its rotation in the flux N. The two voltages E_R^1 and E_R^2 combine to give the resultant rotor voltage E_R, which produces the rotor current i_R; i_s is the stator supply current.

A unipolar repulsion motor is also possible, but is more complicated, and shows no corresponding advantages as compared with the plain induction motor.

Keighley Lighting.—The T.C. has reduced the charges for energy to 4½d. per unit for a consumption under 250 units, and 4d. for a consumption over, or an alternative rate on the maximum demand system of 7d. per unit for the first hour, and 2d. afterwards. For power purposes the charges are as follows:—Under 2,500 units, 2d.; 2,500 and under 5,000, 1¾d.; 5,000 and under 15,000, 1½d.; 15,000 and under 25,000, 1⅜d.; 25,000 and over at a rate to be agreed. For tramway purposes a charge of 1⅜d. is made for all units consumed.

BLAST FURNACE GAS AND ELECTROLYTIC WORK.

By W. H. BOOTH.

It is eight years since the writer contributed to the Electrical Review (April, 1898) an article on the potentialities of blast furnace gas as a motive power agent. In that period, the use of this gas has gradually extended on the Continent of Europe, until now some 200,000 H.P. are being derived, as stated in the Electrical Review of February 16th, 1906, from blast furnaces. Yet nothing, or next to nothing, has been done, by the ironmasters of Great Britain towards utilising the 2½ millions of horse-power represented approximately by the waste gas of their furnaces. The system was pioneered in this country by Thwaite, who first carried it into practice also, and, though quickly grasped by the Continental manufacturers as an aid to economy, nothing of serious importance has been carried out in Great Britain to employ what is a proved success. At the time of the writer's article of eight years ago, and previously, he had ventured to express the opinion that the use of blast furnace gas need meet with no hesitation ; that success was assured. In those eight years the gas has been instrumental in creating the large gas engine in Belgium and in Germany, and our English gas engine makers, who had previously led the world in gas engine practice, have been reduced to the position of licence holders for making engines of foreign design. We have seen such an installation as the Ocker Hill power station put down almost in the middle of a lot of blast furnaces capable of supplying far more power than this coal-burning station. Other power stations have been put down that might equally have been worked by blast furnace gas.

Proposals to smother the town of St. Neots with smoke from a coal-burning station are now before the public, though but a few miles more distant from London there are blast furnaces of considerable capacity that could be drawn on for the power required.

During the eight years referred to, a large electro-metallurgical industry has sprung into being. It demands cheap electricity, and the industry has settled about Niagara and in the Haute Savoie, where water-power is available. In this country, one of our few falls has been taken in hand at Foyers, far enough from industrial centres, and probably at a cost in capital and carriage greater than would have been necessary, had some blast furnaces been drawn upon for the necessary power. For electrolytic work the blast furnace, running as it does 24 hours per day, is peculiarly suitable. After a blast furnace has done its work in producing iron, its waste gases per pound of fuel burned will produce more power in a gas engine than the same weight of fuel will produce in the best modern engines. Gas engine thermal efficiency has been shown to exceed 25 per cent. By neglecting this valuable by-product, the English people, who seem to be so very much unemployed at present, have given away both the honour of pioneering work and the more solid profit of the new metallurgical and chemical industries which require cheap electricity.

The British Aluminium Co. hope soon to have 30,000 water horse-power at work, an amount of power that would be obtained from less than 2 per cent. of the blast furnaces of the country. To utilise a water power is a very costly matter : and water powers are by no means conveniently placed as regards the industrial centres of the country, and we all know the story of the American tourist searching for Lodore, who was told that he was sitting on it—a *dénouement* that does not occur with the blast furnace, than which no more steady power producer exists, especially when a group of three or more furnaces deliver their gas to a common main, thus equalising both flow and quality.

Had the blast furnace problem been taken seriously in hand eight years ago, copper to-day would not be costing over £70 per ton, for there would be many thousands of tons of aluminium to take its place in many directions.

A NEW METHOD OF CASTING COPPER.

The difficulty experienced in making sound copper castings of high conductivity has always hitherto been a source of great inconvenience to the manufacturers of electrical apparatus ; we have pleasure, therefore, in bringing to their notice a method for which important advantages are claimed. The new process, devised by Mr. Alfred Collett, depends not upon alloying the copper with any other metal whatever, but wholly upon the use of a particular flux, and the pure copper retains its high conductivity to a very great extent. The inventor of the process is prepared to guarantee that the impurities contained in his castings shall not exceed ½ per cent., and that the castings shall be so ductile that they can be hammered out cold practically to a knife-edge without splitting, doubled up and hammered flat without showing signs of fracture, and forged hot without flying. The maximum conductivity that has been obtained is 92·5 per cent. of that of pure copper, and the minimum 75 per cent. ; a value of 80 to 85 per cent., we are assured, can be

Fig. 1.

Fig. 2.

safely reckoned upon, as compared with the 20 per cent. found in gun-metal and other copper alloys. It follows that the cross-section of the metal can be reduced to less than half, probably to one-third, of the usual value, with a corresponding reduction in the weight of metal used, and in the prime cost. As compared with wrought copper, the saving in labour is very considerable, and the resulting conductivity is often higher in the casting than in the forging. The castings are guaranteed to be sound and free from blow-holes.

The system has been in operation for the past 18 months, at the works of the Nickel Bronze Co., Birmingham, where castings ranging from 1 oz. to 1 cwt. are made ; intricate patterns with as many as eight cores have been successfully dealt with, and, indeed, the firm are prepared to supply high conductivity copper castings to any patterns that can be got out of the sand in either gun-metal or brass. The accompanying illustrations represent a cast copper solenoid weighing 16 lb., which is now in our office ; fig. 1 shows the solenoid as originally cast, while fig. 2 shows it in its present condition—*i.e.*, cruelly crumpled up with a hammer, to illustrate its soundness and ductility. The London agent for the process is Mr. Philip S. Doherty, to whom we are indebted for the loan of the casting in question.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Indian Appointment.

With reference to the statement, published in your "Personal Column" in your issue of February 9th, to the effect that a Mr. David Scott has been appointed electrical engineer and adviser to the Government of Bengal, it seems that the *Dundee Courier* is hardly correct. Neither Mr. Meares, who, as you are aware, is the electrical adviser to the Government of India, nor I, have any information on this matter, and if any change were contemplated in this direction I should, most probably, have been informed of it by this time.

A. V. Taylor,
Electrical Inspector to Government of Bengal.

Bhowanipore,
March 1st, 1906.

E

(series motor), or with only inductive connection between

for all units consumed.

The Naval Engineers and Electricity.

I was pleased to see a "Maker" call Mr. Smith to account for his sweeping assertion regarding Mr. Wordingham's work in connection with the electrical progress in the Navy. The statement made in the article to the effect that little had been done in the way of improvement since Mr. Wordingham became connected with the Admiralty is a crass misstatement of the actual facts, which can only mislead those not in touch with the work actually being done in this branch of naval engineering. In view of the radical changes that have taken place in the system (not to speak of the improvements on practically every fitting, even to the smallest switch), it is difficult to see wherein Mr. Smith gets the slightest reason for the statement.

Although I am not a maker (worse luck), I am in a position flatly to contradict the writer on the point referred to, and am personally quite willing to leave the progress of electricity in the Navy in the hands of the man now responsible. The only way I can account for the statement is by endeavouring to believe that the writer of the article is wholly unaware of the work actually being carried out on the *Lord Nelson*, or even the *Fly* class.

Scots Toun.

Preservation of Hanger Bolts.

With reference to the article by Mr. R. N. Tweedy, which appeared in your issue of December 29th last on the preservation of hanger bolts on electric tramways, and his proposal to patent a shield or annular disk cut out of fibre, rubber, &c., for placing between the ear and the bolt, I would point out that experiments have been tried with such a shield on the Sydney tramways for the past six months.

It is well known that the revolving trolley wheel throws the rain water up inside the bell of the hanger, and for a time seriously affects the insulation resistance, but I do not consider that the action which takes place is due entirely to water being thrown up during rain, but is more probably caused through the condensation of moisture at night time, especially where the lines are run in the vicinity of the sea coast and the air is laden with moisture of a saline nature. This action has been particularly noticed where the lines run near the sea coast, but I consider it is only partly due to the leakage of the trolley line current. The two dissimilar metals, viz., iron and copper, coming into contact with the saline moisture acting as an electrolyte, must cause such action to take place, apart from the trolley current. I have particularly noticed that where steel bodies have been attached to the iron bolts, the action referred to is not nearly so marked as in the case of iron bolts and gun-metal ears, and the interposition of a shield of fibre or some other tough insulating material will prevent the intimate contact between the two dissimilar metals referred to, and thus reduce the corrosive action which takes place.

This trouble can be overcome to a great extent by chipping the rust from the bolts, and by thoroughly coating the junction of the iron bolt and gun-metal ear with a bituminous compound.

Before Mr. Tweedy goes to the expense of taking out patent rights for such a simple arrangement as that referred to, it might be as well if he inquired whether such obvious experiments had been tried by other tramway systems.

Robt. D. Dixon.

Sydney, *February 6th*, 1906.

An Electrical Solar Hypothesis.

Your correspondent, Mr. Mackenzie, in his highly appreciated letter, draws my attention to the fact that eight years have elapsed since my articles appeared on the above subject.

It is also true that discoveries in the domain of science and of transcendent importance have been made in this period of eight years. Mr. Mackenzie, himself, has named some of the more important ones, which, as he suggests, to a certain extent, at least corroborate my electrical solar and planetary hypotheses.

I feel myself bound to accept your correspondent's courteous invitation to express, at some future date, with your kind permission, my thoughts on the scientific discoveries made since 1898, and as to their effect in corroborating or disproving the reasonableness of my main and minor hypotheses, formulated, perhaps, too briefly and too crudely in the Electrical Review in 1898, and under the *nom de plume* of "Delta," the authorship of which, at your correspondent's request, I now acknowledge.

B. H. Thwaite.

Westminster, *March 19th*, 1906.

The Single-Phase Induction Motor.

Mr. Creedy lays great stress on his contention that diagrams or a properly constructed equation are essential to the full understanding of any theory of the single-phase induction motor, and gives as an example my own remarks before the Institution on the 8th inst., which, he says, were made clear by the use of diagrams. This is a side issue which it would be advisable to eliminate. I think I am right in saying that a great number of leading engineers carefully avoid all articles containing diagrams or mathematics, whilst others prefer to deal with engineering problems with the help of such, but, of course, also follow contributions devoid of mathematics. As I stated on page 274, second column, line 18 from bottom, I considered the theory I was putting forward so simple that it could be fully set forth without the use of diagrams or mathematics, and I made an attempt to do so, in order, of course, to make my theory accessible to the greatest number of people. Whether I have succeeded in my attempt is not for me to say.

All this does not mean, however, as Mr. Creedy assumes, that I personally disbelieve in diagrams. I constantly make use in my work of what could be called partial diagrams, very little more complicated than those I showed at the Institution, but I confess that as a practical man I have no use for the complicated and thoroughly complete diagrams which one so often finds in the technical Press; I try to follow them to the best of my ability, occasionally glean a hint or two, and then—forget them. It should be easy to show up verbally the points illustrated by the simple diagrams I made use of; it is, at the same time, quite possible that I have failed to do so.

This ought to make my position quite clear with regard to this question; the matter must really be left to the decision of each individual, and no general rule can, I think, be stated. One thing is very certain, however, and that is, that Mr. Creedy's criticisms are steadily clearing the ground. I am not prepared to quarrel with him as to whether the ground is to be cleared with or without the help of diagrams, all I desire is to get to the rock bottom, and I will gladly concede any point to that end.

Mr. Creedy is practically correct in stating that I have overlooked the effect which he considers to be absolutely vital to the action of the induction motor. According to my view the ingenious effect or cycle of effects which Mr. Creedy describes does not take place.

I still maintain that absolute absence of self-induction is the condition without which the armature current cannot be in phase with the E.M.F. (E T — E B). As I have already pointed out in my letter of February 24th, the fact of expressing this E.M.F. as a difference pre-supposes exact phase opposition between E T and E B.

Contrary to Mr. Creedy's view, I am of opinion that the self-induction in the armature axis exists at synchronism as well as at any other speed.

I recognise the existence of the two fluxes M and M_2 in the armature axis, I also agree that M_2 is responsible for E S, and that by rotation in the secondary leakage flux, an E.M.F. (E R_1) is set up along the motor field axis, but from this point onwards my views differ totally from those of Mr. Creedy.

The main E.M.F. acting along the axis D D, and which Mr. Creedy does not consider, is E R, as I have stated in my article; in phase E R is opposed to M. The small E.M.F. (E R_1) due to M_2 and of opposite phase to the latter is more or less in quadrature with E R, the exact phase relation between the two depending on the phase of the armature current. Thus in the axis D D we have two E.M.F.'s (E R)

and E R_1 differing in phase by about 90°, it is the *resultant* of these two E.M.F.'s which must determine the magnitude of the current in that axis and the phase of the motor field. If, as in the case of my compensated motor, an auxiliary E.M.F. is introduced into this circuit, a further component is added which must also influence the magnitude of the resultant.

Now this small E.M.F. (E R_1) will shift the phase of the motor field so as to bring E B out of phase with E T (as indicated in the diagram fig. 32 which I showed on the screen at the last Institution meeting). I referred to this condition in my letter of February 24th, and also at the meeting already referred to. I characterised this condition as absolutely vital to the operation of a shunt induction motor, and I showed that my method of phase compensation entirely depended on this very shifting of the phase of the motor field.

It is easy to see that the effect of the secondary leakage field M_2 is beneficial to the operation of these motors, not because an E.M.F. is set up through its agency in the armature axis, and cancels E S at synchronism, as suggested by Mr. Creedy, but because M_2 is partly instrumental in bringing about that phase difference between E T and E B, which I characterised as essential to the satisfactory operation of a shunt induction motor, and which I declared did actually exist, giving at the same time one reason why such a phase difference must be present. This consideration clearly shows that E S is *not* cancelled at any time by the method described by Mr. Creedy.

The effect of E R_1 can be easily gauged, E R is proportional to M and the speed, whereas E R_1 is proportional to M_2 and the speed. Now the secondary leakage flux must, of course, be kept down as low as possible for all its beneficial effect, for it increases E S which unfailingly reduces the output, whilst the beneficial effect of M_2 is attained at the cost of a phase displacement of the motor field; I have shown that such a displacement if carried too far, also decreases the efficiency. The secondary leakage flux must not, therefore, exceed narrow limits, and will only amount to a very small percentage of the mutual induction flux M. Since E R_1 is practically at right angles to E R, their resultant will be very little different from E R, either in phase or magnitude.

Were Mr. Creedy's contention correct, and did E S really disappear at synchronous speed, then it would be quite safe to allow the secondary leakage flux to assume any desired proportions: I fancy, however, that a motor built on such lines would not give a very great output.

Then, again, if the free speed of a motor is really that at which E S vanishes, how is it that a series induction motor, for instance, has a free speed at all, and by what means does E S vanish in that case, if it vanishes at all?

I presume that, notwithstanding its "entire uselessness" the two-phase shunt motor to which Mr. Creedy refers has some free speed or other. Mr. Creedy himself says that E S does not disappear in such a motor, this being, according to him, the sole point of difference between that motor and the ordinary shunt induction motor. How, then, does this two-phase motor manage to have a free speed?

The two-phase motor to which Mr. Creedy refers is no doubt that shown in fig. 2 on page 273. The machine is not perfect as shown, and is, of course, as old as the hills: nevertheless, it suited my purpose to refer to it, but I did not at the time enter into a consideration of its merits. Since Mr. Creedy has raised the point, I may say that this particular machine can be, and has been, made *perfectly* satisfactory. I shall have occasion to refer to points connected with such machines at no distant date.

Not having been able to agree with Mr. Creedy so far, I fail to follow his remarks about the advisability of regulating the motor field in preference to varying E T. Much depends, of course, upon how E T is varied, and his remarks are not very clear in that respect. In my article I have not gone into the question of the best way of regulating the speed of such motors, very much can be written on that subject alone, and it is very lucky indeed that such a multiplicity of ways are at our disposal, for the matter cannot be dismissed in the easy fashion which seems to satisfy Mr. Creedy. The choice of the means must be governed by circumstances, but, amongst others, the question of sparking will always remain of paramount importance. The considerations which must guide us in this respect are those I put forward in a letter dated February 4th, and addressed to the *E.T.Z.*, in which I criticised the views of a prominent adherent of the rotary field theory. (This letter, by the way, has not yet been published, although it ought to have taken its turn last Thursday.)

In order to obtain good commutation, it is always necessary to try and arrange for the E.M.F.'s acting in the short-circuited coil to cancel out as far as possible, leaving the reactance voltage alone to be dealt with. Considering, for instance, the brushes in the armature axis, we have two important E.M.F.'s to bear in mind apart from the reactance voltage; the one E C_1 is statically induced by the motor field, the other E C_2 is due to rotation in the transformer field. As regards phase, they are all but opposed, and practically cancel out at synchronism.

One example will suffice to illustrate my meaning. Let the speed be increased by reducing the motor field; then E C_1, which is independent of the speed, and only depends on the motor-field, will decrease in the same proportion as the latter, whereas, since the transformer field has remained unchanged, and the speed has increased, E C_2 will increase and in proportion to the speed. Commutation will be worse than at synchronous speed, and in order to improve it, it is necessary to sufficiently reduce the transformer field whilst keeping E T constant. In this way E C_1 can be made to equal E C_2 at any desired speed. All this, together with a number of other important points, are fully dealt with in my patent applications.

The reason why Mr. Creedy has arrived at the obviously incorrect power factor at no-load, in his attempt to determine the no-load current on the lines I suggested, is to be found in his own declaration. He says himself that he has been unable to make the calculation I suggested, but instead has made a simpler one. Well, his calculation is *too* simple, and leaves out of account the phase of the rotor current in the armature axis, although in mine of February 24th I particularly draw attention to the fact that the phase of this current is not to be overlooked. Dealing with the matter graphically, it comes roughly to this: unto the vector which represents the no-load current of the transformer in the armature axis, must be added a vector equal and opposed to the one representing the armature current. It is easy to see that as long as the armature current is not co-phasal with E T the resultant no-load current of the motor may very well be equal to 1·7 times the magnetising current in the transformer axis without the power factor being as high as Mr. Creedy's approximation would tend to show.

Mr. Creedy says that with the help of the rotary field theory, he can prove that the no-load current of a single-phase shunt induction motor must be equal to twice the magnetising current of the machine. What is the use of that, if in reality the no-load current *is not* twice the magnetising current?

I believe the rotary field theory to be based on a series of assumptions which are contrary to the facts: in my humble opinion it is a remarkably ingenious substitution of an imaginary for the real sequence of events. The end result obtained with the help of this imaginary motor agrees, not quite, but surprisingly well in most vital points, with the results obtained with the real motor.

Now what I ask is, why invent new principles when the old ones will do, and why attach oneself to a theory which is hedged in by endless diagrams and whose course is made more difficult by plenty of necessary mathematics, so that only a select few can thread the maze, being themselves liable at each turn to step into a hidden pitfall, in order to finally arrive at a not quite satisfactory explanation; when all that is necessary is, if I may so express myself, to translate the tale told by figs. 14 to 16 of my contribution from "continuous" into "alternating?" In the continuous-current machine we have constant and alternating fields, E.M.F.'s and currents; in the alternating current machine all our fields, E.M.F.'s and currents are alternating, and I really feel inclined to say that the alternating-current motor is the general, and the continuous-current motor the special case.

Referring to Mr. Punga's letter, I have to congratulate him on having reached independently the same conclusions as I have. The various Patent Offices can no doubt be

I feel myself bound to accept your correspondent's courteous invitation to express, at some future date, with your

between the two depending on the phase of the armature current. Thus in the axis D D we have two E.M.F.'s (E R)

trusted to fairly apportion to us the means whereby to reap such material benefits as our endeavours entitle us to.

Val. A. Fynn.

London, *March 17th*, 1906.

Walthamstow Cables.

You were good enough, a short time ago, to notice in your journal a controversy which had arisen upon the Walthamstow Urban District Council with regard to the electrical engineer to this Council purchasing cables for wiring the baths from a firm other than the one holding the contract with the Council.

The engineer claimed to have purchased a superior quality cable, with which he had had experience for similar work, at an extra cost of 15 per cent. over the contract prices of the cable usually supplied, and at the same time he obtained the sanction of the Committee to do so.

It was alleged by Councillor Hawley that the cable so purchased was only of the same quality as that supplied under the contract, and that the extra cost was absolutely unnecessary, and thereby a loss to the Council.

The matter being one, as your article suggested, for reference to an independent authority, it was decided by the Council to place the matters in dispute before the Cable Makers' Association to ask them to be good enough to reply to certain questions.

The Cable Makers' Association has been good enough to reply to these questions, and I am directed to forward you a copy of the correspondence, questions and answers, the result of which is, in the opinion of the Council, a complete vindication of the action of the electrical engineer in the matter.

Trusting you will be good enough to give this communication a place in your next week's issue, and thanking you in anticipation.

J. H. Fooks Bale,

Electrical Engineer and Tramways Manager.

Walthamstow, *March 12th*, 1906.

[*Copy.*] Walthamstow Urban District Council.

Town Hall, Walthamstow,
March 3rd, 1906.

Dear Sir,—I am directed by the Council to ask if you would kindly supply answers to the following questions:—

1. Is a 600-megohm 3/22 cable equal to a cable of the same size in the 300-megohm grade?
2. Is the cable which has been supplied by Messrs. Quicke & Co. (as shown in the enclosed invoices) identical with or superior to (so far as insulation is concerned) that which could have been purchased from Messrs. Henley's under their contract for 3/22 600-megohm cable?
3. Taking class for class, do you consider Messrs. Connolly's cables superior to those of any other maker?

Yours truly,
C. Sydney Watson, *Clerk.*

A. H. Howard, Esq., Secretary,
Cable-Makers' Association,
Parliament Mansions, Victoria Street, S.W.

[*Copy.*] Cable Makers' Association,
Parliament Mansions, Victoria Street,
Westminster, S.W.
March 8th, 1906.

C. Sydney Watson, Esq., LL.B.,
Clerk to the Council,
Walthamstow Urban District Council,
Walthamstow.

Dear Sir,—In replying to the questions asked in your favour of March 3rd, it is necessary to point out the distinction between a "600-megohm cable" and a "600-megohm grade cable."

The expression "600-megohm grade" is applied to cables insulated with a certain quality of rubber to the standard thicknesses. This quality of rubber will, when applied to the largest sizes of rubber cable in common use give an insulation resistance of 600 megohms per mile. The same grade of rubber, when applied to the smaller cables, gives considerably higher insulation resistances. Thus, a 3/22s, 600-megohm grade cable will be guaranteed to test not less than 1,250 megohms per mile, and a 3/22s, 300-megohm grade cable will be guaranteed to test not less than 800 megohms per mile. These figures will be found in any of the catalogues of rubber cable manufacturers. The expression "600-megohm cable" simply means a cable, which, on being tested in the ordinary way, will show an insulation resistance of 600 megohms per mile.

Thus, the answer to your first question is "No." That is, a 3/22s 600-megohm cable (namely, one testing 600 megohms per mile) is not so good as a 3/22s cable of the 300-megohm grade, which will test 800 megohms per mile.

In answer to your second question. The cable mentioned in Messrs. Quicke & Co.'s invoices is Messrs. Connolly Bros.' Class D, which is the 600-megohm grade.

The cable asked for in your specification and tendered for by Messrs. Henley's is a 600-megohm cable, for which Messrs. Henley's have tendered the 300-megohm grade, as all the sizes mentioned in the specification will give more than 600 megohms per mile insulation resistance; therefore, the quality invoiced by Messrs. Quicke & Co. is superior to that you could have obtained from Messrs. Henley's under the contract.

This answer must not be taken to imply in any way that Messrs. Connolly Bros.' cables are superior to Messrs. Henley's, who, of course, also manufacture the 600-megohm grade. The only point is, that as your specification only calls for a 300-megohm grade, Messrs. Henley's have naturally only tendered for this.

In reply to the third question, Messrs. Connolly Bros. are members of the Association, and make a good quality of cable, but I am not prepared to say that I consider their make to be superior to that of any other associated makers.

It may help you in clearing up this question to know that in February, 1905, the prices of all cables were raised 15 per cent., which accounts for the considerable difference between Messrs. Henley's and Messrs. Connolly Bros.' prices.

I return the papers forwarded enclosed, and trust the above information will make the matter clear to you.

Yours faithfully,
The Cable Makers' Association,
A. H. Howard, *Secretary.*

[We regret that Mr. Fooks Bale has seen fit to revive this question in this manner, if only for his own sake. His letter reached our hands at 1.30 p.m. on Wednesday last week, and was therefore too late for inclusion in our "Correspondence" columns. In the meantime it has come to our knowledge that the Walthamstow U.D.C. did not meet, either in Council or in Committee, to consider the reply of the Cable Makers' Association. How, then, could the Council either pass an opinion on the latter, or direct the engineer to forward copies of the correspondence to the Press?

As for the reply itself, we fail altogether to see how it vindicates the action of the electrical engineer. Messrs. Henley had a running contract to supply cables to the U.D.C. according to a given schedule of prices; the electrical engineer, knowing this, nevertheless placed an order, or orders, with another firm to supply cables at a higher price, class for class. What more need be said?—Eds. E.R.]

Referring to the letter sent you for publication by Mr. Fooks Bale (a copy of which I have seen) *re* my allegation as to the irregular purchase of cable made by him in his capacity of electrical engineer to the Walthamstow District Council, I would like to point out that up to the time of my writing this, the reply of the Cable Makers' Association to the question submitted to them has not been considered by the Council or any of its Committees; it is, therefore, clear that Mr. Bale has no authority for sending you either the copies of the correspondence between the Council and the Cable Makers' Association, or his letter stating that the Council are satisfied with his action in the matter.

Dealing with the questions submitted to the Association, it is obvious that they can be but mere incidents in the course of a discussion which has spread itself over some five months. Briefly put, the charge I have made against Mr. Fooks Bale is, that well knowing that a contract under the seal of the Council had been made with Messrs. Henley's Telegraph Works Co. for the supply of rubber-covered cable, he elected to place orders with Mr. C. F. Quicke at a cost of 15 per cent. higher than he could have obtained the same class of cable for from the Council's contractors. I would also like to point out that the wiring of the baths, which Mr. Bale specially mentions, was a comparatively small matter, as the bulk of the cable was used upon very ordinary work. In regard to Mr. Bale's statement that he had the sanction of the Committee, you have already shown in your article of February 9th that this was not so.

W. H. Hawley,

Member of Walthamstow District Council.

London, W.C., *March 20th*, 1906.

U.D.C. Promptness.

As an example of British slackness, will you allow me to bring the following to your notice.

In the early part of last December, I applied to a certain urban district council for one of the munificent (!) jobs that they offer from time to time in their electrical department. I have just received back my papers this evening (March 20th, 1906), so that I have been kept something over a quarter of a year for a reply to my application. I leave comment to your readers, for I am—

Disgusted.

Shift Engineers' Holidays.

I have read with interest the correspondence going on at present as to the treatment of shift engineers. "Shift Engineer" and others will have noticed that batches of correspondence on this subject appear periodically in these columns. No sooner, however, have shiftmen realised the value of it, and suggested remedies, than the matter drops. It has been suggested in previous letters that a Union be formed. I think this, with rules drawn up to suit the requirements, would help to remedy a lot of injustice to shift engineers. I would suggest a committee be formed to organise such a union, which could be done for a small annual subscription.

It would be interesting to hear other views on the matter. It is obvious that something must be done, if not to increase, at any rate to put a stop to the decrease of, the salaries of shift engineers. Believe me, beloved shiftmen, so long as companies and committees can get trained and experienced men at a mere bread and cheese living, they will continue to do so.

Ali Segarni.

The effort of "Another Engineer-in-Charge" to find out whether, and how, the grievances of shift engineers can be redressed will be accorded a hearty welcome by all central station men.

There is absolutely no doubt that the supply of young electrical engineers is far in excess of the demand; hence the niggardly remuneration, which in many cases is literally "blood money." Whence this superfluity?

If a young fellow has an engineering turn, and the time has come for him to decide, in nine cases out of ten the choice is left to him. Electricity is the coming thing.

Promptly a prospectus is written for. After wading through regulations, training, premium, &c., there comes a long list of appointments:—Mr. A, switchboard attendant; Mr. B, sub-station engineer, and so on. The qualifications, and, consequently, the remuneration of electrical engineers are by no means common knowledge; and if the college is a large institution and the premium high, the natural deduction of the parent is that switchboard attendants, and others in similar positions, are receiving about £2 per week. Most colleges find posts for a large percentage of their pupils, but 95 per cent. of these are still obliged to live on the bounty of their parents; hence the colleges are a source of cheap, well-trained and reliable men to central stations.

I think it the duty of the daily Press to make public the money paid to central station engineers; this I consider would tend to keep out a great number. Then the shift engineer would not be so helplessly at the mercy of his chief and the lighting committees. "Rome was not built in a day"; but if the paltry remunerations were made public, no doubt we should feel the beneficial effects of this move in a couple of years.

There is scarcely any need to go as far as South Africa to inquire into the right of one man to enslave his fellow. If we were to sum up the conditions under which the shift engineer works to the detriment of his health, and a fortnight to recuperate, for the munificent return of £2 to £2 10s., with the consolation that there are hundreds willing to take his place, we should find evils enough to be redressed.

Are the voices of the victims of circumstances going to die away like cries of distress in the wilderness, and can nothing be done?

De Profundis.

LEGAL.

London Hydraulic Power Co. v. the St. James' and Pall Mall Electric Light Co., Ltd.

In the High Court on Wednesday and Thursday last week, Mr. Justice Farwell, sitting as an additional Judge of the King's Bench Division, had before him an important action arising out of the bursting of a water main in Piccadilly Circus last July.

Sir Edward Clarke, K.C., in opening the plaintiffs' case, said that although the actual amount claimed by the plaintiffs was under £200, they asked for a declaration that would affect liabilities of a very considerable sum. The plaintiffs had about 150 miles of hydraulic mains through London and about 6,000 customers, who had power supplied for lifts and other purposes. In 1888 plaintiffs laid a main through Piccadilly Circus, and in 1889 the defendants, without giving any intimation whatever about it, constructed a manhole or inspection chamber for their electric service directly over the main and in such a way that two sides of it rested on the plaintiffs' main. It was a strong 6 in. pipe 1¼ in. thick made to stand a pressure of 2,250 lb. to the square inch, whereas the pressure actually put upon it was only 750 lb. On July 10th last, about 8.15 p.m., the pipe burst, and the water burst up the wood paving almost as far as Pall Mall. It was not until nearly midnight that the escape was located, and not until a great deal of damage had been done. Plaintiffs claimed from the defendants the cost of repairing the main, and the value of 300,000 gallons which escaped. They also asked for a declaration that the defendants were liable to indemnify them in respect of any amounts for which they might be liable by other persons who suffered injury. The defendants denied that they were responsible for the bursting of the pipe, and counterclaimed for damage done to their electric mains in Piccadilly Circus. They alleged that the plaintiffs were guilty of negligence in failing to take prompt measures to isolate and check the outflow of water.

A number of witnesses called by the plaintiffs, gave evidence to the effect that there was no defect in the pipe; that the burst was not due to excessive water pressure in the pipe; and that immediately the burst occurred, prompt measures were taken to stop the outflow of water, and prevent further damage. Various witnesses gave it as their opinion that the two walls of the inspection chamber which rested on the defendants' main, transmitted the vibration of the traffic overhead, and led to the fracture of the pipe.

For the defendants, expert evidence was given on Friday and Saturday with a view to proving that there had been a subsidence in the neighbourhood, which was quite sufficient to have caused the breakage of the plaintiffs' main. Several of the defendants' witnesses further stated that, having regard to the point at which the break occurred, it could not have been occasioned by vibration arising from the passing of traffic over the inspection box.

His Lordship concluded the hearing of the case on Monday. He held that the plaintiffs had failed to prove that the bursting of the main was due to any act of the defendants. The action would therefore be dismissed with costs. On the defendants' counterclaim for £35 odd, judgment would also be entered for the defendants with costs.

Pembroke Urban Council v. Dublin United Tramways Co.

According to *Freeman's Journal*, in King's Bench Division No. 1 (Civil Side) on 14th inst., before Mr. Justice Boyd, in this case Mr. Wood G. Jefferson applied on behalf of the plaintiffs for an order for discovery of documents. The action was brought by them against the Tramways Co. for £8,413 15s., their alleged contribution towards the widening of Ballsbridge. Counsel alleged the existence of letters and documents which it was essential that the plaintiffs should see before trial of the action.

His Lordship, after some argument, granted the application.

Child v. A. J. Harris & Co.

In the Chancery Court on 16th inst., Mr. Ashton Cross applied for the appointment of a receiver and manager. Counsel said his client was the registered holder of four out of 20 debentures in the company, and the company themselves admitted that the appointment of a receiver was inevitable. Mr. Frank Mellor having been heard for the company, Mr. Justice Warrington made the order asked for.

Coburn v. Great Northern and Brompton Tube Railway.

Before the High Bailiff of Westminster on 14th inst., plaintiff, who owns certain property in Long Acre, claimed compensation from defendants on the ground that the existence of tube railways beneath the said premises depreciated their value. A verdict was given for the defendants.

Action against the Metropolitan Electric Tramways Co.

On Monday last, before Judge Smyley, a cab proprietor brought an action to recover damages from the above-named company for the loss of his horse and damages to a cab. The horse ran against one of the company's poles. The jury found for the plaintiff, awarding £63 damages, and judgment was given accordingly.

less than 800 megohms per mile. These figures will be found in any of the catalogues of rubber cable manufacturers. The expression "600-megohm cable" simply means a cable, which, on

Member of Walthamstow District Council.

London, W.C., *March 20th*, 1906.

PARLIAMENTARY.

L.C.C. and Middlesex County Council Tramway Bills.

Lord Onslow presided on Monday over a sitting of the Standing Orders Committee of the House of Lords, when petitions by the London County Council and the Middlesex County Council for the suspension of Standing Order No. 22 of the House were considered.

Mr. Brown, presenting the case for the L.C.C., said that the two Bills were taken together, as so far as a portion of the tramways was concerned, the Bills were competing Bills. This particular tramway was about 3½ miles long, and extended from Cricklewood to the Marble Arch at the junction of the Edgware Road. The line was a double one, and the road along which it ran was under the jurisdiction of the Borough Councils of Hampstead, Paddington and St. Marylebone, and the U.D.C. of Willesden. The resolutions passed at the joint conference of those authorities were evidence, he considered, that the construction of the tramway along the Edgware Road was not only not objectionable, but was desirable. Although the consents of the Borough Councils had not been explicitly and specifically given, as was required by the Standing Order, he asked the Committee to construe the Standing Order so that all that was necessary had been done.

Mr. Pritt having spoken for the Middlesex County Council,

Mr. Greg reminded the Committee that the Edgware Road was one of the most important thoroughfares to and from London. There was an enormous traffic on it, and it was a matter for the road authority to say whether or no it was a proper road for a tramway. There was no proposal to widen the roadway sufficiently, and at one point, near the Kilburn Brewery, it would be less than 18 ft. wide.

The Parliamentary agent for the Hampstead Borough Council then addressed the Committee, and Mr. Brown having replied, it was decided that the Standing Order should be dispensed with in both cases.

The Standing Orders Committee of the House of Commons has decided that the London County Council be empowered to proceed with their Bill on condition that the powers to construct Tramways Nos. 4, 5, 6, 6A, 7, 7A, 7B, 7C, 8, 8A, 9, 17, 17A, 17B, 17C and 20, be struck out of the Bill.

In the case of the Middlesex Council's Bill, the Standing Orders Committee have decided that it shall be allowed to proceed.

London County Council (Tramways and Improvements) Bill.

The Court of Referees sat on Thursday last week for the purpose of considering a number of cases of *locus standi*.

In the case of the above Bill the L.C.C. objected to the *locus* of the London omnibus owners.

Mr. Lewis Coward, for the petitioners, said that the London omnibus owners claimed to be heard on grounds of competition, but particularly in respect of a clause in the Council's Bill which enabled the Council to lay down temporary rails during the proposed re-construction of the tramways for electric traction. In this connection learned counsel pointed out that last year Mr. Justice Warrington granted an injunction against the Council in this matter. The clause which the Council had inserted in their Bill was really to render them immune from action at common law in case of accidents. The temporary rails were often 6 in. above the roadway, and 'buses could not run over them. As to the competition, it was in various parts of London, and a part of it would be due to the linking up of existing tramway systems.

Mr. Erskine Pollock, K.C. (for the L.C.C.) said that the omnibus owners were seeking an unlimited *locus* against the Bill.

Sir Chandos Leigh: But they would be content with a *locus* against these particular sections.

Mr. Coward agreed. The petitioners, he said, did not want to interfere with the improvements.

Mr. Pollock observed that the rails were put down for the public convenience. Omnibuses by no means represented the traffic on the streets.

A Member of the Committee: But they carry passengers.

Mr. Pollock: So do hansom cabs, but there are no cabmen going in this petition. It was a question which ought, if raised at all, to be raised by the local authority.

The Court allowed a limited *locus*.

Todmorden Corporation Bill.

The Todmorden Corporation Bill came before the Police and Sanitary Committee of the House of Commons on Wednesday, March 14th.

Mr. Moon, K.C., for the promoters, stated that a few years ago the Corporation had proposed to establish a tramway system, but doubting if the expenditure would be warranted, the scheme was abandoned. The present Bill was to enable the Corporation to run a service of motor-omnibuses. There would be four routes, each commencing at the Town Hall, and terminating respectively at the tramway termini at Burnley, Bacup, Rochdale and Halifax. It was considered that the 'buses would be more economical than tramcars, they would be cheaper in first cost, and it was a moot point whether motor-omnibuses were not a better means of conveyance. It had now been acknowledged that not only was it within the sphere of a local authority's work to provide means of conveyance, but it was said to be the duty of such authority to do so. That applied to tramways, but he could not see why the same principle should not apply to motor-omnibuses.

The clause was approved, and the further consideration of the Bill postponed.

Mersey Railway Co.

A Select Committee of the House of Lords, presided over by Earl Cawdor, met on Tuesday to consider a Bill promoted by the Mersey Railway Co.

Mr. J. D. Fitzgerald, K.C., in opening the case, said that the only portion of the Bill which was to be opposed was that by which the company sought power to run omnibuses for the purpose of conveying passengers to and from their stations. Numerous requests had been received by the company asking them to start omnibuses, and they decided to apply to Parliament in order that any doubt as to their right to run such a service might be put at rest, and in the meantime they started six motor-'buses which carried between them 7,000 to 8,000 passengers a week. The Birkenhead Corporation, thinking that the company was more effectually competing with their ferry and tramway service, obtained an injunction against them, and the omnibuses were discontinued. The Liverpool Corporation was also petitioning against the Bill.

Mr. James Falconer, chairman of the company, said that the traffic on the Mersey Railway had not increased at the rate they had anticipated it would with the introduction of electricity. That was largely because the company had not facilities for taking passengers to and from their stations. They wished to have a service of motor-omnibuses simply to act as feeders to their line.

Mr. Alfred Gill, the town clerk of Birkenhead, gave evidence in opposition to the Bill, and said that he did not think there was any need for a service of motor-'buses. In his opinion, the Corporation tramway system amply served the district.

The Committee adjourned.

New Group.—A Select Committee of the House of Commons, consisting of Messrs. C. Williams (chairman), R. Duncan, E. B. Barnard and Younger, has been appointed to consider the following Bills:—Macclesfield and District Tramways, London Southern Tramways, London County Council Tramways, Middlesex County Council Tramways, Corporation of London (Blackfriars Bridge), and London United Tramways.

London United Tramways Bill.—On Thursday last week, the promoters of this Bill appeared before the Court of Referees, and objected to the *locus* of the Staines Rural District Council and the Sunbury Urban District Council. After hearing the Parliamentary agent, the Court refused to grant a *locus* in either case.

BUSINESS NOTES.

Switchgear Contracts.—Messrs. Ferranti, Ltd., have recently received the following orders for switchgear:—

H.T. continuous current 2,000-volt switchgear, 36 panels, for Hull Corporation.

Electrically operated switchgear, also L.T. C.C. switchgear, for the St. Andrew's Cross Station, Glasgow Corporation.

L.T. C.C. switchgear for Waterloo Street Sub-station, Glasgow Corporation.

H.T. switchgear for main station, and H. and L.T. switchgear for sub-station, for Lancashire United Tramways Co.

H. and L.T. sub-station switchgear for Manchester Corporation, eight boards.

C.C. switchboard for Messrs. Richard Johnson & Nephew, Ltd., Manchester.

C.C. switchboard extension for National Gas Engine Co., Ashton-under-Lyne.

Extension H.T. switchgear for South Metropolitan E.L. and P. Co., East Greenwich.

Extension H.T. three-phase switchgear for the North Metropolitan E.P.S. Co., Ltd., Taylor's Lane Station.

Electric Sewage Pumping Installation.—The Local Government Board having approved of a scheme of main sewerage and sewage disposal for Bentley with Arksey, Doncaster, the contract for the work has been let to Messrs. G. Mackay & Son, contractors, Edinburgh. The works consist of the laying of 9 miles of main sewers, of cast-iron and fire-clay pipes, but, owing to the water-logged and flat nature of the ground, deep sewers could not be laid, and the district has had to be divided into three sections, each with a separate pumping station. It is proposed to pump the sewage from a small storage tank by means of centrifugal pumps actuated by electric motors. A central generating station is to be erected at the disposal works near to Bentley, from which the necessary cables will be laid to the three pumping stations. To deal with the night flow the power will be obtained from a storage battery. The motors at each pumping station will be started and stopped by means of floats automatically operating the switches so that the whole pumping plant will be worked from the central station. The sewage will be delivered at the disposal works and treated in bacterial tanks and filters, with final treatment over land. The works have been designed by Messrs. D. Balfour & Son, consulting engineers, of London and Newcastle-on-Tyne, and the contract was let at a sum below the engineers' estimate.

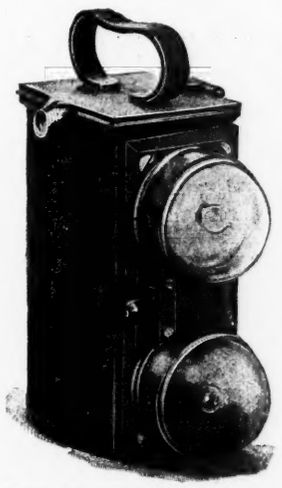
Power-Gas Installations.—The Power-Gas Corporation, Ltd., of 39, Victoria Street, Westminster, S.W., and Stockton-on-Tees, have obtained the order for the power-gas installation for the shipyard of the China Steam Navigation Co. at Hong Kong. The gas plant is capable of producing 300,000 cb. ft. of gas per hour, 75 per cent. of which will be specially cleaned for use in four gas engines—having a total capacity of 3,300 b.h.p.—and 25 per cent. will be used in furnaces and other heating appliances. As the working conditions require continuous running day and night throughout the year, the plant is designed so that any of the main parts can be isolated without interfering with its operation. The installation includes three producers of the Mond patent type, but it is arranged to allow of future extension. Eastern fuels of a bituminous character are to be used.

The engines are of the Cockerill type, made by Richardsons, Westgarth & Co., Ltd.—the main contractors—and will be direct-coupled to Dick, Kerr dynamos. The whole of this installation is to the requirements of Messrs. Swire & Sons, of London, the agents for the China Steam Navigation Co.

This is the first important gas-driven power station for the East, but the Power-Gas Corporation's patent plant has been installed at many of the principal shipbuilding and engineering works in this country, among which may be mentioned such important firms as :—

Cammell Laird & Co., Birkenhead.
John Brown & Co., Ltd., Clydebank.
Armstrong, Whitworth & Co., Manchester.
Richardsons, Westgarth & Co., Ltd., Middlesbrough.
Wm. Beardmore & Co., Ltd., Parkhead and Dalmuir.
D. and W. Henderson & Co., Glasgow.
Blair & Co., Ltd., Stockton-on-Tees.
The Clyde Shipbuilding and Engineering Co., Ltd., Port Glasgow, N.B.

Electric Signalling Hand Lamps.—The Electrical Power Storage Co., Ltd., have lately issued a circular relating to their electric signalling hand lamps for railway use, shunting purposes, &c. The lanterns are arranged so that either a red or a



E.P.S. Hand Signalling Lamp.

white light is shown as desired. The lamps are all fitted with the high-efficiency "Osmi" filament. The illustration shows one of these equipments with an enamelled metal outer case. A somewhat cheaper one is also supplied, having a polished wood outer case.

Germany.—The Deutsch Russischer Electricitats-zahler Gesellschaft is the name of a company which has just been formed in Cologne to manufacture electricity meters.

Factory Act Prosecution.—According to the *Yorkshire Daily Post*, at Bradford on 13th inst., Mr. W. H. Seal, H.M. Inspector of Factories, prosecuted the Rhodes Electrical Manufacturing Co., Ltd., for having employed persons before and after proper hours and at meal times. Mr. Seal said that when he visited the works, the first girl he met told him an untruth about her age. When he had left, the manager gave the girl a shilling, saying, "That is for what you told the inspector. When he comes again, you must do the same." The Act did not say anything about the instigator of false statements, but he asked for the defendants to be treated with some severity. Defendants were fined £1 and 11s. costs in each of three cases.

Kieff Electrical Exhibition.—The *Board of Trade Journal* reports that the Electro-Technical Exhibition, which was to have been held at Kieff on March 25th to April 7th, 1906, has been postponed until April, 1907. The Congress of Electro-Technical Engineers has also been postponed till that date.

Rubber Exhibition in Ceylon.—The *Chamber of Commerce Journal*, Liverpool, states the Rubber Exhibition arranged for April or May this year has been postponed until September next to enable the Exhibition to be a thoroughly representative one, and of wide scope. The committee will consist of about six planters.

Gas Power Plant.—In connection with the Swanscombe Works of the Associated Portland Cement Co., Ltd., we understand that Messrs. Masons Gas Power Co., Ltd., have received instructions to proceed with the erection of a 2,400-b.h.p. bituminous coal gas power plant required to work in connection with seven Oechelbauser gas engines of 350 b.h.p. each. The gas plant will consist of three gas generators, each of 800 b.h.p., with the necessary cooling and cleaning plant. It is considered that the successful results obtained on the 1,800-b.h.p. plant at the works of the Reading Electric Supply Co., Ltd., formed a large factor in aiding the Masons Gas Power Co. to secure this important contract.

Chimney Contract.—We understand that a big electrical plant is being built at the Shelton Iron and Steel Co.'s works, and the order for the chimney shaft (180 ft. high and 8 ft. internal diameter) has been placed with the Ferbeck Chimney Construction Co., of London, E.C.

Book Notices.—*The Manual of Electrical Undertakings and Directory of Officials.* By E. Garcke. London: Electrical Press, Ltd. 15s. net.—With the 1906 edition, this indispensable publication has reached its tenth year. The information it contains now relates to 2,700 electrical undertakings, municipal and private, at home and abroad. The capital issued by companies and municipalities for electrical undertakings is stated to have risen from approximately 267 millions sterling, to 295 millions during the year. The *Manual* is so familiar to most people who have any connection worth speaking of with the electrical industry, that we need not again enumerate its various classified sections. A new section that is added particularises "Electrical Undertakings in the Colonies." Maps, tables, diagrams, and a vast store of information regarding the financial and engineering features of all electrical concerns and the men connected with them, are brought together in such a way as to make the work of immense value for everyday reference.

Les Accumulateurs et les Piles Electriques. By J. A. Montpellier. Messrs. J. B. Baillière et Fils, Paris. 5 fr.—This is one of the "Encyclopédie Industrielle" series, and contains about 300 pages and 130 illustrations. There are nine chapters on storage cells, and five on primary batteries. The book is primarily intended for "practicians," and the information is mostly of a descriptive nature. It is very clearly written and illustrated, and a practical man will find here a great deal of information regarding large and small storage cells and the methods of installing these. The portion of the book dealing with primary batteries is very complete. Cells with single fluid, double fluid and solid depolariser, such as Lalande and Leclanché, are well illustrated and discussed. The book is also carefully indexed, and altogether we have pleasure in stating that as a concise, practical treatise, we can recommend it to our readers.

Modern Buildings: Their Planning, Construction and Equipment. Vol. I. By G. A. T. Middleton, A.R.I.B.A.—The Caxton Publishing Co. 10s.6d. net. In this work the author seeks to impart to the reader in a concise and popular manner the essential features of modern building work, an object which the numerous excellent illustrations, some of which are in colours, go far towards achieving. The scope of the work is a wide one; it is intended to explain in detail the planning of all classes of buildings, and will embody the principles of both British and Colonial architectural and building practice. The work will consist of some six volumes, covering the design of domestic, public, ecclesiastical and miscellaneous buildings; constructional work embracing the operations of the various trades directly concerned; specification writing, and quantity surveying. A section of the work promises to deal with electric lighting in some detail, to which we hope to refer at some length in a later issue. We should infer from Vol. I., which covers office practice, draughtsmanship, the planning of cottages and country houses and ordinary constitutional details, that this work will be of great value to students and the younger members of the architectural profession and building trades, who have already some acquaintance with the subject.

A Guide to Income and Property Tax Assessment and Recovery. By H. Theobald. London: The Pioneer Press. 3s. 6d.—This is a useful little work on a subject which appeals to large numbers of taxpayers. The writer holds, with some justification, that the majority of such have practically no knowledge of this subject, and some may not even know that they are paying income-tax because it is deducted at the source. His object in this work has been to set out, in a concise manner, one's rights and obligations. Among the eight sections are those dealing with points affecting property owners, public employments, traders, professional men, &c., and one of the fullest relates to "Exemption and Abatement," with model forms. A "Table of Cases" is given.

The Locomotion Problem. By Charles Bright, F.R.S.E., M.I.E.E. London: P. S. King & Son. Price 1s. net.—This little book is made up of three lectures which were delivered at the Uxbridge Literary Institute, and in part at Toynbee Hall. The author objects to the imposition of a legal speed limit for motor vehicles, believing that pre-existing laws which deal with "driving to the public danger" are more satisfactory and ample for all developments. The same views may be urged with much force with respect to the more or less arbitrary limitation of the speed of tramcars. While agreeing generally with the friendly remarks on p. 41 about electric motor-cars, we take exception on obvious grounds to the statement that for street travelling "the electric brougham is, of course, a much more satisfactory chariot than the older vehicle drawn by a pair of prancing bays—*though incapable of going any faster!*" It is open to question whether in England "tramways came into existence as a protest against bad road surfaces." Applied to America,

oint whether motor-omnibuses were not a better means of con-

contract was let at a sum below the engineers' estimate.

that would be much more nearly correct. A query, too, must be put after "When once these (roads) are rendered really smooth the necessity for tramways—with their numerous objections—will entirely disappear, in many districts at any rate." We suggest that by the time the road surfaces have been brought to such perfection that the tractive effort required to propel motor vehicles is no greater than that exerted by tramcars of equal capacity and equal speed, the whole of the conditions governing the problem of transit will have altered so materially that no one now alive can adumbrate more than obscurely the path of action. Meanwhile the shareholders in tramway undertakings (always including ratepayers in that category) need not be alarmed on that account, although they well may be on others. Mr. Bright is not at all antagonistic to tramways; no man who takes a wide view of the locomotion problem can be; and he presses once more the futility of splitting up road jurisdiction among many petty authorities when parochial bounds have no relation to traffic. Nobody but those who have been engaged in the preliminaries of creating a tramway serving even a small area can have any conception of the worry and work and expense (call it not blackmail!) for which this antiquated division of control is directly responsible. In the course of the third lecture, an attempt is made to compare the merits of automobiles, tramways and underground railways, and the familiar arguments in favour of the first are brought out again. Mr. Bright overlooks the fact, long known in the United States, and becoming common knowledge here at last, that wherever a quick service of tramcars is run, other vehicles do not think it advisable to use the tracks, so that the speed of cars is not affected in any considerable degree by other and slower vehicles.

Notes on the Home Office Rules for the Use of Electricity in Mines. By W. C. Mountain. Price 2s. 6d.—As might be expected with the introduction of new rules for the use of electricity in mines, a great deal of misconception appears to exist in the minds of mining engineers and colliery owners, as to the actual meaning of the rules, and how they are to be satisfactorily carried out. This, of course, is quite in accordance with all "law," and whoever knew of any "Act" that did not require a lawyer (ofttimes in vain) to explain what was intended, or what some clause meant. In this case Mr. Mountain has undertaken the duty of the lawyer, and we must say has succeeded very well indeed, and we have no hesitation in saying that the pamphlet will prove exceedingly useful to the non-electro-technical colliery manager upon whom is thrown the *onus* of carrying out the rules. The pamphlet commences with concise definitions of electrical terms; then follows each rule printed in red ink, with an explanation of the rule in black where necessary; it is accompanied by formulæ, tables, &c., and is, further, liberally illustrated by diagrams, and typical examples of instruments, switches, junction boxes, and other accessories, in order to render the meaning clear. We note a *leather* cable suspender is shown, and it may be interesting to our readers to know that at one colliery where these were put in, and which was infested with rats, it was found the latter had a remarkable liking for greased leather, and that they gobbled them up almost as fast as they were fixed. We can scarcely agree, however, with Mr. Mountain's explanation of Rule 2, which says:—A competent person shall be on duty at the mine when electrical apparatus or machinery is in use; and at such time as the amount of electricity delivered down the mine exceeds 200 B.H.P., a competent person shall be on duty at the mine above ground, and another below ground. This, of course, depends upon the meaning of the word "competent," and Mr. Mountain thinks that "a man who is intelligent and possesses no particular trade qualifications would be quite competent to look after electrical plant, if he had sufficient knowledge to ensure the machinery being kept clean and in good working order; but such a man would probably require instruction either by the manufacturer of the machinery, or by a man on the colliery who had previously attended to machinery of this description." Now, this is merely "tinkering," and even with the latter qualification of "instruction by the manufacturer," the competent person would only be a "tinker"—in fact, not so good, as a "tinker" usually does know his trade. No, we certainly think the man should have some trade qualification—in our opinion, that of a "fitter," with electrical experience—and it would pay the colliery manager to employ such a person. With this exception—and, after all, this is merely an opinion—we can quite agree with everything Mr. Mountain says, and have no hesitation in recommending the pamphlet to colliery people interested in the use of electricity. It concludes with a number of useful tables and formulæ.

"Journal of the Institution of Electrical Engineers." Vol. 36, No. 176, February, 1906. London: E. & F. N. Spon, Ltd. 5s.

"Elektrotechnik in Einzel-Darstellungen." Edited by Dr. G. Benischke. No. 7. "Aufnahme und Analyse von Wechselstromkurven." By Dr. E. Orlich. Brunswick: Fried. Vieweg & Sohn. M. 3.50.

"Proceedings of the American Institute of Electrical Engineers." Vol. XXV., No. 2, February, 1906. New York: The Institute.

"Index Review of the Engineering Press." Vol. VII., No. 4, Jan., 1906. Brussels: Association de la Presse Technique. 2.50 fr.

"Return of Higher Education in England and Wales (application of funds by local authorities) during the year 1903-4." The Board of Education. London: Wyman & Sons, Ltd. 2s.

"The National Physical Laboratory Report for the Year 1905." Teddington, Middlesex: The Laboratory.

"The Transactions of the South Yorkshire Association of Mining Students." Vol. I., No. 1., January 1st, 1906. Rotherham: The Secretary, 3, Braithwell Street, Denaby Main.

"The Chemistry of Materials of Engineering." By A. Humboldt Sexton. Second edition. Manchester: The Technical Publishing Co., Ltd. 5s. net.

Catalogues and Lists.—Messrs. Bagshawe & Co., London.—Circular relating to accessories for chain and band elevators.

Messrs. W. H. Bailey & Co., Ltd., Salford.—Illustrated catalogue (No. 496) fully describing and pricing their Thurston patent recording oil testers, also the Ingram & Stapfer oil testers, Boult's cylinder-lubricant tester and Redwood's viscometer.

Messrs. T. A. Rose & Co., 56 and 57, Aldermanbury, E.C.—Catalogue illustrating and pricing various electric pocket lamps, hand lamps, and other novelties. Messrs. Rose are the sole agents in the United Kingdom for the dry and the renewable batteries manufactured by Messrs. Schmidt & Co., of Berlin.

Messrs. Alfred Herbert, Ltd., Coventry.—New catalogue Section "D," giving particulars, prices and neat half-tone illustrations of their various sensitive drills.

Messrs. Venner & Co., 6, Old Queen Street, S.W.—Circular showing the "Venner" time switch and the method of its action.

The Chloride Electrical Storage Co., Ltd., Clifton Junction, Manchester.—Pocket-shaped catalogue (112 pp.) particularising the various improvements in detail which have been effected in the Chloride accumulator. The various types of plates and cells are shown for central station, traction, launch, telegraph and other services, and many data are brought together in convenient table form. Prices are quoted for many types, as well as for various accessories. The company has also published a shipping catalogue which contains prices and particulars of batteries, including packing for shipment and delivery f.o.b. English port, and also includes full shipping specifications of all the company's standard sizes. Such information as this should be of considerable service to customers abroad, as it must save correspondence delays.

Messrs. Elliott Bros., Lewisham.—New pamphlet (No. G62) describing, illustrating and pricing their moving-coil portable galvanometer.

Messrs. Ernest F. Moy, Ltd., Camden Town.—Priced circular describing their type 4 porcelain bridge fuse-box for pressure up to 250 volts.

Bankruptcy Proceedings. — Shadrach Ferris, electrician, 11, Broad Street, Swindon.—A receiving order has been made on debtor's own petition. First meeting and public examination to be held at Swindon on March 28th.

G. A. Benton, electrical engineer, Shareshill.—First meeting and public examination at Wolverhampton, on March 28th.

Dissolutions and Liquidations.—The Clift Manufacturing Co., Ltd.—This company is winding up voluntarily, with Mr. Harper, of 27, Chancery Lane, W.C., as liquidator. A meeting of creditors was to be held last Monday.

McGuire Manufacturing Co., Ltd., 2, Queen Anne's Gate, Westminster.—A second and final dividend of 5s. 5d. in the £ is payable on March 30th at 58, Coleman Street, E.C.

Pollak-Virag Telegraph Syndicate.—Creditors must send particulars of their debts, &c., to the liquidator, Mr. W. S. Ogle, 90, Cannon Street, E.C., by May 5th.

New British Engineering Co., Ltd.—A meeting is to be held at 20, Bishopsgate Street Within, E.C., on April 20th, to hear an account of the winding up from the liquidator (Mr. G. Frampton).

National Co. for the Distribution of Electricity by Secondary Generators, Ltd.—A meeting is to be held on April 20th to hear an account of the winding up from the liquidator (Mr. J. H. Thornton).

Trade Announcements.—We understand that Messrs. Hanke, of Ladowitz, represented by Mr. Archibald Campbell, of Chancery Lane, W.C., have greatly enlarged their electrical department by building large new kilns, which will enable them to make prompt deliveries of porcelain or china insulators, cleats, roses, cut-outs, distributing board parts, &c.

Mr. G. O. Donovan, M.I.E.E., has resigned his position as works director of the Electrical Trades Supply, Ltd., Birmingham, and has started the firm of Donovan & Co., 12, Barwick Street, Birmingham, electrical manufacturers and suppliers. Mr. Donovan was with Messrs. Veritys, Aston, from 1897 to 1905, and we understand that for some years, as works and business manager, he was in entire control of their electrical factory, manufacturing motors, switchboards, arc lamps, &c. Messrs. Donovan & Co. have a large stock of all general supplies for the use of contractors in the Midlands.

The Union Electric Co., Ltd., state that a Mr. Harwood, who has been calling upon various firms, is not, and has not been, in their employ.

The Mica Insulator Co., Ltd., has changed its name to "The Micanite and Insulators, Ltd.," a title which it is felt will more correctly represent the business of the company. The constitution and *personnel* of the business remain as heretofore.

The British Prometheus Co., Ltd., have this week removed their works and head offices from Kingston-on-Thames to Salop Street Works, Highgate, Birmingham, where all communications should be sent. The London showrooms are at 27, Ely Place, Holborn Circus, E.C.

Messrs. Palmer & Co., electrical engineers, notify that they have removed to their new showrooms and offices at 7, Great Castle Street, Oxford Circus, W., where they will have an extensive show of electrical motors, heating and cooking apparatus, electric light fittings, &c.

Messrs. Gillies & Hornidge and the Buckingham Electric Light Co. notify that on and after March 26th their London address will be 6, Holborn Viaduct, E.C.

The International Electrical Engineering Co., of London and Liége, have appointed Messrs. Oxley & Wilde, 37, Surrey Street, Sheffield, to be their sole representatives in the Midlands.

LIGHTING and POWER NOTES.

Acton.—The U.D.C. has approached the Metropolitan Electric Supply Co., from whom it is taking a bulk supply of energy, for a revision of the terms. The company intimates that it will, under the agreement, reduce the charge for a period of three years, as from April 1st next, from 3d. per unit for the first two hours' supply, and ¾d. after, to 3d. and ½d. Subject to the company's Bill in the present session being passed, it has informed the Council that it would be willing to take over and work the Council's order as from October next for a period of either 36 or 42 years. The terms of such a scheme have been before the Council, and it has been decided not to accept the company's proposal. The reduction in the price is considered insufficient, and the company has been asked to still further reduce same.

Beverley.—The T.C. has asked the B. of T., "under the special circumstances of the case," to extend the E.L. order for a year.

Bexhill.—The T.C. has adopted a recommendation of its E.L. Committee to introduce an alternative flat rate of charge for energy, of 5½d. per unit as from the 31st inst. Discounts to consumers charged on this system are to be allowed every 12 months as follows: 10 per cent. on accounts of £25 and over, 15 per cent. on £50 and over, and 25 per cent. on accounts totalling £100 or over.

As regards the financial position of the electricity undertaking, in a review of the town's finances last week, the Mayor stated that, since March last, a small profit has resulted on the working.

Birkenhead.—The T.C. has adopted a recommendation to extend the generating plant at its Bentinck Street station at a cost of £11,896.

Brighton.—The T.C. and the Assessment Committee have arrived at a settlement with regard to the assessment of the Southwick power station and the electricity works at Brighton. The assessment of the Southwick station was fixed at £6,000, bringing the total assessment of the undertaking to £16,251. The assessment at Southwick is to be £5,000, that of the Brighton works is to be reduced from £9,971 to £7,000 for two years, and that at Preston is to remain at £280.

British Central Africa.—An electrical plant recently installed at the Church Mission station of Livingstonia derives its power from a stream situated 2 miles distant. The plant consists of two sets of 30-H.P. turbo-alternators, working under a head of 110 ft. of water. The turbines were built and supplied by the Ateliers de Construction Mécanique, Vevey, Switzerland, and drive three-phase alternators by means of flexible couplings, the speed being 1,000 r.p.m., and the frequency 50 cycles. The alternators were constructed by the Maschinenfabrik Oerlikon, Zurich. Power is transmitted through three lines of No. 6 S.W.G. hard-drawn copper wire, and reduced by transformers to 190 volts for the motors and 115 for lighting. Sawing and brickmaking machinery, flour mills, a printing press and various wood-working tools are driven by three-phase motors. When fully installed the plant will supply 600 16-C.P. glow lamps. The scheme was carried out under the supervision of the Mission's engineer, Mr. Chalmers.

Continental Notes.—Spain.—The Compania de Electricidad de Senitarlea has been formed to generate and supply electricity for lighting and power purposes in the town.

At Huercal-Overa (Almeria) a new company is to erect a hydro-electric plant, and to supply the district with electrical energy.

Mr. C. T. de Tolentino has been instructed to carry out the electric lighting of Cubas and Cillero, and energy is to be supplied from the power station at Chavin.

Italy.—La Société pour Enterprises Electriques has been formed by the amalgamation of the electrical concerns of Prealpine and Varesine, and proposes to undertake the distribution of electrical energy in the Varese district, and to take over and work several railway and tramway undertakings.

Denmark.—A German contemporary states that a Danish company proposes to exploit the water-power of the River Laga, in Sweden. The scheme is to construct two power stations on the river and to transmit the energy overland to Helsingborg and thence by submarine cable to the Danish coast.

Sweden.—In regard to the production of steel by electricity, experimental power plants are in contemplation to utilise the water-power in the country to develop the industry, and to cover the cost the imposition of a small tax on exported ores is proposed.

Germany.—It is stated in the German Press that the Krupp Co., of Essen, have decided to adopt electricity for the production of steel, and that Messrs. Siemens & Halske, of Berlin, have been authorised to carry out the necessary works.

Switzerland.—A concession is being sought by the Kanderwerke Co. for the erection of a water-power station on the Reichenbach, to be equipped with five 1,000-H.P. generating sets.

Carrickfergus.—A scheme is on foot for the lighting of the town by electricity during the coming winter.

Coventry.—The City Council had before it last week the recommendation of the E.L. Committee to spend another £35,000 on extensions to plant and buildings at the E.L. station. The recommendation met with considerable opposition, and after discussion the report was referred back for further details.

East Ham.—A L.G.B. inquiry was held last week into an application by the B.C. for sanction to a loan of £18,750 for E.L. purposes. Opposition was offered on the part of the Ratepayers' Association.

Edinburgh.—The E.L. Committee has had before it a report by Prof. Sir Alexander Kennedy on the proposed new condensing scheme for the M'Donald Road station. It was agreed to abandon the clauses in the Corporation order relating to the scheme, under which it was proposed to utilise the Water of Leith.

Flixton.—Replying to the objection of the P.C. to its area being included in the E.L. order being applied for by the Barton R.D.C., the latter body has informed the B. of T. that a parish council has no power or right to require the R.D.C. to consult it on questions arising under the order.

Glasgow.—The question of lighting the new suburb of Hillpark and Southend has been before the electricity department of the Corporation, which has communicated with the Renfrew C.C. on the subject. The County Council are considering the letter in connection with the application of the Clyde Valley Electric Power Co., to supply electricity to portions of Cathcart and Eastwood.

Hipperholme.—Owing to a canvas for prospective E.L. customers having proved unsatisfactory, the U.D.C. deferred the question of E.L. for the present. To justify the carrying out of a scheme, an annual consumption of 27,000 units was considered necessary, but the canvas only resulted in between 4,000 and 5,000 units being asked for.

Holyhead.—The electrical engineer has reported that there is now a load of 161 KW., and as the capacity of the plant only totals 120 KW., he cannot meet next winter's demand unless the Council install additional plant. The municipality seems very reluctant to increase the plant, but has agreed to allow its engineer to report as to whether some plant, which was stated to be on sale at Newcastle, is suitable.

Hucknall Torkard.—An extension of the E.L. order has been applied for by the U.D.C., which has also asked the Nottingham and Derbyshire Electric Power Co. what it proposes to do with respect to supplying energy to the district.

Leicester.—The E.L. Committee has reported that the department had during the half-year ended December 31st last, made a profit of £4,259. Out of profits, £16,300 has been expended on new machinery, and there is now a balance of £1,801, with which it is proposed to purchase three boilers.

Loughborough.—On Saturday last at 1.50 p.m. a fault occurred in a service box, which had been laid the previous day. It was located on one length of distributor by 4.30 p.m., when the network, with this exception, was made alive. The fault was repaired by 9.30 p.m., very little inconvenience being caused to consumers. In all probability the box was damaged by the Highways Department in reinstating the pathway.

According to the *Nottingham Daily Guardian*, negotiations are now in progress between the Corporation and the Brush Electrical Engineering Co. for a supply of energy to the company, which will mean the extension of the plant; as an alternative, the transfer of the undertaking to the company is given.

London.—Metropolitan Asylums Board.—An interesting statement on the relative cost of gas and electricity has been submitted by the engineer-in-chief to the Works Committee. It is shown that at the Eastern Hospital in 1903 the cost of gas only was £1,414, in 1904 gas only until September, and then with electricity combined, £1,366; in 1905, with both gas and electricity, £774. These figures show that the total expenditure for gas and electricity combined for the year 1905 was £592, less than for 1904, and £639 less than for 1903, when only gas was used for lighting and cooking. The Committee remarked that "these results we consider most satisfactory, more particularly when regard is had to the many other advantages such as greater purity of atmosphere and reduced cost of annual cleaning and decorative works with which the introduction of electricity as an illuminant into an infectious hospital, is inseparably associated." The total cost of installing the electric light at the Eastern Hospital was £3,445.

Bermondsey.—Condensing plant is to be installed at an estimated cost of £2,350.

From the 31st inst. arc lighting is to be extended from midnight till 1 a.m., and the charge reduced from 3d. to 2¼d. per unit. Special terms are to be allowed large firms in the district with a view to improving the load factor.

Marylebone.—The Council has come to an agreement with the Regent's Canal Co. for the construction of a lay-by, and proposes to erect on the site coal conveying plant at a cost of £717. An automatic coal handling plant is to be obtained for the generating station at a cost of £1,703, and the work will be carried out by Messrs. Babcock & Wilcox. £400 has been paid for property to settle an alleged vibration nuisance.

The Council is to be permitted to use the Regent's Canal water for condensing purposes to the maximum amount of 3,000 H.P., and to pay an annual rent of £250 for the same, also to give the canal an annual traffic of not less than 6,000 tons. If the traffic exceeds 6,000 tons, permissible H.P. is to be increased *pro rata*, without any increase in the rent.

Stoke Newington.—The Mayor is to perform the ceremony of starting the machinery in connection with the Council's electricity supply at an early date.

F

Camberwell.—The G.P. Committee on Tuesday reported having received notices of appeal in respect of the laying of electrical conduits in three streets. It instructed the town clerk to attend the hearing on behalf of the Council.

L.C.C.—At the meeting on Tuesday it was decided to advance £48,545 to the Marylebone B.C. for alterations to works and mains consequent upon the change in the pressure of supply. It was stated that the B.C. had borrowed nearly £2,000,000 for electric lighting purposes.

Islington.—A public meeting was held at Islington on the 15th inst. under the auspices of the Ratepayers' Association, to protest against the B.C.'s action in erecting new arc lamps for street lighting, and a resolution was carried to this effect.

Poplar.—The electrical engineer has submitted to the Lighting Committee a statement showing the comparative cost of gas and electricity for public lighting. In September, 1900, all the street lighting was by gas. The number of lamps was 1,742, and the total c.p. was 29,824. In September, 1905, the number of lamps was 1,775 (899 electric; 876 gas). The total c.p. was 657,984 (629,952 electric; 28,032 gas). The annual cost per c.p. in 1900 worked out at 55·96d. The cost per c.p. in September, 1905, worked out at 4·37d. (3·59d. electric; 21·99d. gas). An offer by the London and India Dock Co. to take energy at ·885d. per unit, subject to a three years' agreement and a guarantee to take a minimum of 300,000 units per annum, with a maximum load not exceeding 100 kw. at any time, has been accepted.

King's Norton.—A refuse destructor which has been built by Messrs. Heenan & Froude for the U.D.C. at Lifford was officially opened recently. The building and plant cost about £14,000. Arrangements are being made with a syndicate for using the steam to generate electricity for lighting and power purposes. The syndicate proposes to put down plant near the destructor, and to take over the powers under the Council's electricity order for a short period.

Macclesfield.—In reference to our note in last week's issue, Mr. W. R. Brown, wholesale ironmonger, electrical engineer and cycle agent, Macclesfield, writes that our information was "evidently from a partisan source." He continues:—

"Without referring to the subterfuges which have been resorted to by the majority of our local Town Council to delay the introduction of electricity, either by a company or the Corporation, I beg to point out the following errors in your notes.

"1. The voting was *against an amendment* to the proposed abandonment 'that no action be taken until the Inspector's report had been received.' But the Council preferred to act on certain remarks made by the Inspector at the very beginning of the inquiry, and before he knew anything of our local wants or circumstances.

"2. It is untrue that the Inspector made any such foolish statement as 'that £20,000 at least should be the initial expenditure.'

"2 He said nothing about any other 'big expenditure in prospect,' nor is there any other such so far as I, as a member of the Council, know of, except the purchase of a new gas-holder, which is being paid for out of the maintenance fund.

"4. It is untrue that the 'strong opinion against the scheme is led by Col. Brocklehurst, M.P.' That gentleman has not taken any part in the discussion of the subject since he formed one of a deputation to the Board of Trade 12 months ago, and promised that if the Board would refuse a certain firm's application for a provisional order the Council would at once proceed with a scheme. The Council having fixed a limit of £16,000 and had a scheme prepared by a competent engineer, they now abandon it without waiting for the L.G.B.'s report."

Our information was derived through the ordinary news channels—a Press correspondent—but we have before us a full report of the discussion appearing in the *Macclesfield Times*. There it is stated that Alderman Fountain moved: "That this Council proceed no further with the present electricity scheme." An amendment was moved by Councillor Coppock to the effect that "the Council take no action until the report of the L.G.B. inspector has been received." For this amendment 15 voted, but there were 26 against, and the report adds, "the Mayor declared Alderman Fountain's resolution carried." Does Councillor Brown wish us to understand that though the amendment was lost, the original motion was *not* carried? The "foolish" statement attributed to the Inspector is not very different from that credited to Councillor Brown that a scheme could be worked on £16,000 "to commence with." Councillor Brown is reported as saying "it was very misleading to . . . say they expected £16,000 would cover everything connected with the scheme. He did not think anyone except a lunatic would dream of such a thing." "The inspector described the proposal as a skeleton scheme, but no one suggested that it was anything else." £16,000, then, for a skeleton scheme—how much more for one dressed with extras? £4,000? We cannot admit that there is any error in (1), and in regard to (2) there is little difference of consequence between the alleged statement of the inspector and that of Mr. Brown; and respecting (4) Alderman Fountain stated at the Council meeting that Alderman Brocklehurst, M.P. (who was absent) had said twelve months ago that "there did not appear to him to be any great demand for electricity in Macclesfield, and it would be better to let a company prepare a scheme." In regard to (3) we have no local information regarding public works in prospect—perhaps probable extensions to the electricity scheme itself were in mind.

We have no concern with the merits of the controversy—we are merely concerned to show that Mr. Brown's charges of partisanship are not justified, and that such "errors" as he points out are not errors at all. In any case the points are quite unimportant.

Ormesby.—The U.D.C. gives notice in the *London Gazette* of its intention to transfer its prov. order to the Cleveland and Durham County Electric Power Co.

Portslade.—The U.D.C. has agreed that the Joint Committee appointed to go into the question of providing the district with electricity, shall ask their several Councils to allow them to expend a sum not exceeding 20 guineas in getting expert opinion, "so that they might know where they were in dealing with that very astute body, the Electricity Committee of the Brighton Corporation."

Pudsey.—An Exhibition of electrical appliances was held in the Corporation electricity works last week. The display was illustrative of the uses of electricity in the home. A number of manufacturing firms lent apparatus for the purposes of the Exhibition.

Salford.—The Electricity Committee has proposed to the Corporation that the L.G.B.'s sanction be obtained to its borrowing £7,720 to cover the cost and installation of a new turbo-generator and condensing plant at the Frederick Road station. This has been adopted.

Sheffield.—An amendment for the rejection of the recommendation that Sir William Preece be retained at a fee not exceeding 100 guineas, to advise the Committee as to the desirability or otherwise of combining the Corporation stations for the production of electric energy, whether for lighting, power or traction, and also as to utilising the waste steam produced at the refuse destructors for the generating of electric power, has been carried.

South Africa.—The T.C. of Ladybrand has decided to approach the Government for a loan of £10,000 for electric lighting, water supply and other purposes.

The T.C. of Heilbron has declined for the present the offer made by Messrs. Harris, Lee & Co. to take over the latter's electric lighting plant.

The scheme to erect an electric power station driven by steam power on the Vereeniging coalfields, to supply the Rand Mines with electrical energy, has progressed so far that a syndicate of German firms, including the Allgemeine Elektricitäts Gesellschaft and four German banks, and Messrs. Lewis & Marks, of Pretoria, has subscribed the capital of £2,000,000 needed for its consummation; while two engineers of the first-named company are in South Africa to make final reports on the plans. The realisation of this scheme will mean the setback of the electrical utilisation of the Victoria Falls of the Zambesi for an indefinite period.

Sunderland.—The T.C. has rejected the proposal of the City of Durham Electric Power Supply Co. to take over its E.L. undertaking.

A further steam alternator is to be obtained for the Hylton Road station, and electrical plant at an estimated cost of £5,740.

A reduction in the price of electricity is to be made by an allowance of 20 per cent. discount.

Swinton and Pendlebury.—The B. of T. has informed the U.D.C. that the proposed agreement between the Council and the Lancashire Electric Power Co. for the transfer of the E.L. order appears to involve, to a greater or less degree, a divestiture of powers under the prov. order. The Board suggested that there should either be a complete transfer of the order for a period of years, the capital to be found by the company, or an arrangement whereby the Council should establish and work the undertaking and take energy in bulk from the company. The Council has decided to adopt the latter suggestion, and negotiations have been opened with this object in view.

Tiverton.—Messrs. Suter & Co., the contractors for the electric lighting of the town, have suggested to the T.C. that the agreement now in the hands of the L.G.B. should be replaced by separate agreements, one dealing with the construction of the installation, and the other with the running of the scheme afterwards. The Council, however, seems pleased that there is a way out of the contract with Messrs. Suter, and has decided to take no action in the matter.

The L.G.B. has refused to sanction a loan for the electric lighting of the town. The E.L. order was obtained about 15 years ago, and a decision was reached about 18 months ago to install the light municipally at a cost of about £12,000.

Walthamstow.—Cables are to be laid to Highams Park, and application is to be made to the L.G.B. for sanction to borrow £10,146, the estimated cost of the work.

Warrington.—A L.G.B. inquiry was held last week into an application of the T.C. to borrow £7,000 for services, meters and mains.

Waterford.—A deputation of the Corporation has waited on the B. of T. in reference to an application by a company for a prov. order for the electric lighting of the town. The deputation whilst in London consulted an expert on the matter, and in spite of advice to withdraw opposition to the Bill, the Corporation has decided by a majority of one not to withdraw from its former decision.

West Ham.—The borough electrical engineer has recommended the Corporation to adopt a scheme whereby consumers may obtain arc lamps and other apparatus on the hire-purchase system. The proposal is that 15 per cent. be added to the cost and

fixing of the lamps, &c., the consumer to pay 25 per cent. of the total cost down and the balance in two years. Payments may be extended over three years, but in that case 20 per cent. is to be added to the cost. The deposit is non-returnable. The engineer states that provided the Corporation retains full control as to the selection of consumers and the wiring contractors who do the work, no abuses can creep in. This report has been generally approved.

Wisbech.—The Corporation has approved a new draft agreement with the National Electric Construction Co. The latter is to form a new company and repay part of the expenses incurred by the Council on the old scheme. The T.C. agrees to spend not less than £200 per annum with the company.

Wolverhampton.—The T.C. has decided to extend the free wiring system so as to make it applicable to all premises in the borough without regard to rental. Hitherto free wiring has not been carried out on premises let at lower than £40 per annum.

TRAMWAY and RAILWAY NOTES.

Canada.—It is reported that an electric railway, to be called the Canada Central, is to be constructed running from Montreal to Ottawa and on to the Great Lakes.

Continental Notes.—Germany.—The Beuth Prize of the Verein Deutscher Maschinen Ingenieure for the year 1906 will be awarded for a scheme for an electric hill railway 200 km. long. The difference in height between the two end stations will be 500 m. The service will be 50 goods, 10 passenger and three express trains in each direction, the former travelling at a speed of 45 km. and the latter 100 km. per hour. Regard is to be had to the saving by the return of energy to the line. The conductor system chosen must make use of a single overhead wire.

Italy.—Commandeur Andisio, of Florence, has presented to the Italian Government a project for an electric tramway between Livorno-Pisa and the baths of St. Julien for the purpose of obtaining a concession for the work. The new line will pass through the town of Pisa, and will conduct foreigners to the baths at St. Julien, which have been purchased by the Société des Eaux de Lucques.

In order to utilise the power of the Caffaro, a committee has made application for the construction of an electric railway from Brescia *viâ* Nave to the Austrian frontier. The provincial deputation has approved a loan of 600,000 fr. for the construction of this new line. At the same time it has been decided to accord to the Société du Chemin de fer Rezzato-Vobarno-Caffaro a sum of 200,000 fr. for the extension of the Vobarno line to Vestone, Valle Sabbia.

The electric tramway service between Rome and Frascato has recently been inaugurated, says an Italian contemporary. The cars have been manufactured by the Casa Diatto, of Turin, and the motors by the Casa Thomson; they are the fac-simile of the cars used on the Milan-Monza line.

Holland.—The British Consul at Amsterdam reports that a company has been formed there with a capital of £625,000 with the object of constructing an electric tramway from the centre of Amsterdam to many of the more important towns and villages to the north of Amsterdam, having a total length of about 40 miles.

Spain.—The Compania Vizcaina de Electricidad has obtained a concession for an electric tramway at Bilbao.

The project has been approved for an electric tramway from the railway station of Sarria to Vallvidrera. The Compagnie du Chemin de fer de Sarria at Barcelona has made application for the concession.

According to the Spanish Press a service of electric automobiles for passenger traffic is shortly to be installed between Balagner and la Leo d'Urgel, as well as other services.

According to the German Consul at Madrid the administration of the "Sociedad de los Tranvias de Valladolid" has decided to extend the system of tramways and to substitute electric traction.

The construction of an underground electric railway in Madrid is under the consideration of the Circulo de la Union Mercantil.

A concession to construct an electric tramway between Zumarraga and Azcoitia has been granted.

Poland.—The horse tramways in the town of Warsaw are being converted into an electric line. The necessary rails and poles are being furnished by native concerns.

Switzerland.—The equipment of the Valle Maggia railway from Locarno to Rignasco has been entrusted to the Maschinen-Fabrik Oerlikon, Switzerland. The track, 27½ km., with a maximum rise of about 33 per cent., will be built as a narrow gauge line, 1 m. wide, to carry trains up to 55 tons weight, and will be worked with single-phase current at 5,000 volts. The rolling stock will consist of four-wheeled motor wagons, each having four 40-h.p. single-phase motors for both passenger and goods carriages. The motor wagons will be fitted with the Oerlikon patent collectors. For power generation, a waterhead of 250 m. will be utilised, driving two generators, each of 350 k.v.a. The Valle Maggia railway will be the second railway in Switzerland worked by single-phase current, the first being the Seebach-Wettingen line, also equipped by the Oerlikon Works, and using single-phase current at 15,000 volts.

Durham.—The B.E.T. Co. has informed the local authorities that it intends applying to the B. of T. for a prolongation of time to October 4th next for the completion of the works authorised by the Durham and District Light Railways Order, 1901.

Glasgow.—At the half-yearly meeting of the shareholders of the Caledonian Railway Co., on Tuesday, Sir James King, Bart., who presided, said that, owing to the lavish services of electric tramways in the neighbourhood of Glasgow, the short-distance passenger traffic during the past few years had been seriously diminished. In the corresponding half-year of 1901 they carried upwards of 3,000,000 more passengers than in the past half-year. During the last three years the number of short-distance passengers had kept pretty steady, and he was hopeful that they had seen the worst so far as tramway competition was concerned.

Greenock.—The report of the directors of the Greenock and Port-Glasgow Tramways Co. for the year ended December 31st last, states that the number of passengers carried during the twelve months was 7,623,694, as compared with 6,644,388 in 1904. The average receipts per passenger were 1·06d., as against 1·08d.; the average working expenditure per passenger was ·66d., as against ·62d.; and the proportion of expenses to receipts was 62·6 per cent., as compared with 57·5 per cent.

Halifax.—The Corporation Tramway Committee is being urged to accede to a proposal of the West Yorkshire Tramways Co. for running the company's cars over the Corporation tramway system between West Vale and Halifax, and also between Brighouse and Bailiffe Bridge. In consideration of its opposition to the Tramways Co.'s Bill, now before Parliament, being withdrawn, the Corporation is to be guaranteed a profit on the new traffic. If this arrangement is effected passengers will be able to travel from Halifax to Huddersfield, and also from Bailiffe Bridge to Huddersfield, without change of car.

Liverpool.—It is understood that the Lancashire and Yorkshire Railway Co. intends to electrify the line between the Exchange terminus at Liverpool and Aintree, *viâ* Marsh Lane. The line between Exchange station and Marsh Lane is already electrified as a portion of the Southport line. The Aintree line proceeds from Marsh Lane by a curved incline, and crosses the Southport line by means of a bridge. The electric system will thus be extended to Aintree, and probably the next step will be another junction at Marsh Lane with the Liverpool Overhead Railway system, similar to the one at Seaforth.

The report of Lieut.-Col. Von Donop to the B. of T. relating to the tramway accident which took place on January 22nd, states that the driver probably started from the top of the hill at a somewhat high speed, and reversed the current to check the speed, "blowing the switch." He closed the switch and did the same thing again, and then lost his head; the hand-brake was only applied when the car was approaching the curve, too late to prevent a derailment. The maximum gradient on the hill was only 1 in 17·5, and the Inspector considered that the hand and electric brakes provided should have amply sufficed to keep the car well under control, with ordinary care.

Llandudno.—Messrs. Bruce Peebles & Co., who have arranged to take over the Colwyn Bay-Llandudno Light Railway from the original promoters, have obtained the support of the U.D.C. to an application for a further extension of time for beginning operations.

London. — Metropolitan District Railway.—Replying to a question in the House of Commons relative to the number of accidents on the District Railway, Mr. Kearley, on behalf of the B. of T., said he was communicating with the railway company on the matter. There was no reason to suppose that the employment of one man only on the "motor" was a source of danger.

L.C.C.—In answer to questions at Tuesday's meeting, Captain Hemphill, the new chairman of the Highways Committee, said that in four years only about thirty miles of tramways had been dealt with, little more than seven miles a year. During 1906 only 3¾ miles were reconstructed. When it was stated that there were 115 miles of tramways in London that ought to be electrified, and that to give an adequate service there should be at least 300 miles, it was obvious that the work of reconstruction should be expedited.

The Council's policy was frequently opposed and obstructed by borough councils. He did not think the Council would ever consent to private companies running electric tramways in London. It was possible that the Council would ask Parliament for powers to run motor-omnibuses in connection with tramways.

East London Railway.—Correspondents writing to the *Times* are urging the immediate electrification of this line, and of the management. One states that the cost of conversion would be very small, power being derived from Lot's Road, while the rolling stock of the underground lines could then run over the railway. The terms of the lease, however, appear to cause difficulties.

Charing Cross, Euston and Hampstead Railway.—The accident which threw the Charing Cross Railway out of use proved of immense advantage to the above-mentioned tube railway company, as it enabled them, by arrangement with the S.E. and and C.R. Co., to sink their shaft downwards in the station yard, instead of boring upwards at great cost. The work was completed last week, in time for the reopening of the station.

Lowestoft.—As the working of the Corporation tramways has not been attended with a reasonable profit, it has been decided to advance the ordinary fares during June, July, August and September from 1d. to 1½d.

Manchester.—Councillor G. Jackson, the general secretary of the Tramway Men's Union, last week stated that he could not possibly counsel the men to accept the terms offered by the Corporation.

In the event of a strike it will affect 700 drivers and 800 guards. The Tramway and Vehicle Workers' Union, to which the men are affiliated, has accumulated capital to the amount of £20,000, and, in addition, has an income of £450 a week from subscriptions. The bulk of this money would be available for strike pay. The Society claims to be the largest, most wealthy and most powerful organisation of tramway and vehicle workers in existence. In the event of the men deciding to hand in their notices, a fortnight must elapse before the cars are brought to a standstill.

For some time past the Salford men have been in receipt of an extra ½d. per hour for Sunday labour, and there are other little items that make for the betterment of the men's condition. If, however, the Manchester agitation is successful, there is every reason to believe that a similar movement for time and a half would be started.

Oxford.—According to the local Press, an exhibition of the Dolter surface-contact system is to be opened in the town to-day.

Bournemouth.—The Corporation having made application to the B. of T. for permission to increase the existing speed limit for tramcars from 12 to 14 and 16 miles an hour on certain portions of the system, Major Pringle, one of the inspectors of the Board, recently paid an official visit of inspection, and went over the entire system.

On Monday next the Light Railway Commissioners will hold an inquiry with respect to an application for powers to construct a light railway from Bournemouth to Swanage, *viâ* Branksome Park and Sandbanks, and also to build a conveyor bridge over the entrance to Poole Harbour.

Salford.—At the meeting of the Salford Town Council on March 14th, it was resolved that an automatic point controller for the tramways be adopted at an expenditure of £1,488, experiments having proved successful.

Southport.—The T.C. has decided to oppose the application for an extension of time for the construction of the Southport-Lytham electric tramways.

South Shields.—The B. of T. inspection of the electric tramways was to take place on Wednesday.

Taunton.—The T.C. has approved of the increase of speed suggested by the B. of T., and of an extension of the tramways to Rowbarton.

TELEGRAPH and TELEPHONE NOTES.

Canada.—The Select Committee of the Manitoba Legislature appointed to investigate the general telephone conditions and report to the Provincial Government has emphatically endorsed Government ownership of the telephone.

Hull.—The Corporation has considered the proposal of the National Telephone Co. to purchase the telephone undertaking, and has referred the matter back to the Telephones Committee.

London-Glasgow Cable.—The Postmaster-General has informed the secretary of the Edinburgh Chamber of Commerce that the underground telegraph cable between London and Glasgow will be in working order by the 31st inst.

May Island.—Operations connected with the repair of the May Island (Firth of Forth) telegraph cable have been successfully carried out, notwithstanding the recent stormy weather.

Postal Telegraph Clerks' Conference.—Last week the Postal Telegraph Clerks' Association held their annual conference at Birmingham, 92 delegates being in attendance. Resolutions were passed expressing gratitude to the Postmaster-General for admitting the principle of trade unionism, and to the Government for appointing a select committee of inquiry. A resolution in favour of 3d. telegrams was adopted, and various political matters were discussed.

Post Office Servants.—A Select Committee of the House of Commons has been appointed to inquire into the wages and position of the principal classes of Post Office servants, and also of the unestablished sub-postmasters; to examine the conditions of employment of these classes, and to report whether, having regard to the conditions and prospects of their employment and to the standard rate of wages and position of other classes of workers, the remuneration they receive is adequate or otherwise.

Post Office Telegraphs.—An official return relating to the Post Office telegraph and telephone service in the year ended March 31st, 1905, shows that the expenditure exceeded the total receipts by £987,739 10s. The total expenditure was £4,839,458 13s. 5½d.

Swansea.—It is stated that the National Telephone Co. has offered to take over the Corporation telephone system on the basis of reimbursing the Corporation the whole of the expense incurred, as at Hull. The Corporation, however, with other towns, is in negotiation with the Government.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Jamaica-Colon	Jan. 5, 1905	
Cadiz-Tenerif	July 20, 1905	
Tarifa-Tangier	Jan. 18, 1904	
Puerto Plata-Martinique	Oct. 30, 1905	
St. Vincent-Grenada	Feb. 16, 1906	Mar. 18
St. Vincent-St. Lucia	Feb. 16, 1906	
Tangier-Cadiz	Feb. 18, 1906	
Alexandria-Lamaca	Feb.28, 1906	Mar. 20
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Communication with Brazil *via* Galveston	July 18, 1905	
Bachkale-Deliman	Feb. 12, 1906	
Alaska Landlines	Mar. 9, 1906	Mar. 12

Venezuela.—The *Morning Post* deals with the cable dispute in a leader, in which it shows that the "Taigny" affair merely amounted to the "exclusion" of this gentleman from Venezuelan territory and not "expulsion," for he had no right to board the *Martinique* without the assent of the Government to which he was accredited; this was admitted by M. Taigny, and amounted to a technical violation of the prescriptions attaching to his position.

Wireless Telegraphy.—According to the Continental Press, an Austrian officer in the Department of Posts and Telegraphs has invented an apparatus suitable for wireless telegraphic communication at a distance of 70 kilometres, which can be folded and carried by automobile. The length folded is 3½ metres, and extended 26 metres.

CONTRACTS OPEN and CLOSED.

OPEN.

Belfast.—March 27th. Electric lifts for the Technical Institute. Architect, Mr. S. Stevenson, 83, Royal Avenue. Deposit £2 2s., returnable.

Belfast.—April 16th. Coal and ash conveying plant, bunkers and chain-grate stokers. See "Official Notices" to-day.

Belgium.—April 19th. "Maison Communale" Couvin (Namur) are inviting tenders for the electric lighting of the town. Further information may be obtained from the "Secrétariat Communal."—*Board of Trade Journal.*

Bolton.—March 29th. Materials and stores for the electricity department; also one continuous current electric generator and one steam engine. See "Official Notices" March 9th.

Briton Ferry.—March 26th. Sub-station switchboard, feeder and distributor cables, feeder pillars, joint boxes, arc lamps and standards, for the U.D.C. See "Official Notices" March 2nd.

Chester.—March 31st. Construction and electrical equipment of tramways (permanent way, bonds, and overhead equipment) for the Corporation. See "Official Notices" March 9th.

Dover.—April 2nd. Surface condenser and Edwards air pump for the Electricity Department. See "Official Notices" to-day.

Dublin.—March 27th. The Lighting Committee invites tenders for the electric lighting of the Montgomery Street housing scheme buildings. Specification, &c., from the City Electrical Engineer, Fleet Street, Dublin. 10s. 6d. returnable.

Glasgow.—April 4th. Stores and fuel for the tramways department. Specification, &c., from Mr. J. Dalrymple, General Manager, 46, Bath Street.

Gillingham.—March 26th. Coal and meters for the electricity department. See "Official Notices" March 2nd.

L. & Y. Railway.—April 2nd. Stores for 12 months, including signal and telegraph fittings, also signal, telegraph and electric light wires. Mr. Duffin, Stores Department, Osborne Street, Manchester.

Leeds.—April 9th. Steam turbine, two-phase alternator and exciter (3,000 kw.), condensing plant and piping, for the electric lighting department. See "Official Notices" February 23rd.

L.C.C.—March 26th. Lighting and power installation for the Long Grove Asylum, Epsom, now erecting. See "Official Notices" February 23rd.

L.C.C.—March 27th. High and low-tension switchgear for certain sub-stations. See "Official Notices," March 9th.

L.C.C.—March 27th. Three low-tension feeder switchboards for tramway sub-stations. See "Official Notices" March 16th.

L.C.C.—March 27th. Eleven 500-KW. induction motor-generators, and three 50-KW. ditto, for tramway sub-stations. See "Official Notices" March 16th.

Luxembourg.—June 1st. The municipal authorities of Luxembourg are inviting proposals for the public electric lighting of the town, and for the construction of several lines of electric tramways. Particulars may be obtained from, and offers are to be sent to, Le Secretariat de la Ville de Luxembourg.

Perth.—March 26th. 3,000 tons of small coal for the electricity works. Mr. John Lambert, Burgh Electrical Engineer.

Portsmouth.—April 10th. Stores, &c., for the Corporation. See "Official Notices" to-day.

Saffron Walden.—The Council invites offers for the purchase or working of its prov. order. See "Official Notices" to-day.

Salford.—April 21st. One 750-KW. steam turbo-generator and condensing plant. See "Official Notices" to-day.

Stockport.—March 29th. Electric motors, also steam-driven condensing plant for the electricity department. See "Official Notices" March 16th.

Sunderland.—March 28th. Stores, also ticket punches, for the tramways department. See "Official Notices" March 9th.

Sunderland.—March 30th. One 750-KW. three-phase steam alternator, one 300-KW. static transformer, and two portable air compressors for the electricity department. See "Official Notices" March 9th.

Sunderland.—April 4th. Steam, &c., piping for Hylton Road station extensions. See "Official Notices" to-day.

Wallasey.—April 18th. Boilers, 500-KW. steam alternator (single-phase), also extensions to electricity works buildings, for the U.D.C. See "Official Notices" to-day.

Wrexham.—March 23rd. Supplies for the Council's electricity department. See "Official Notices" March 9th.

CLOSED.

Barnes.—The D.C. has placed the contract for a 300-KW. steam dynamo and switchgear with Messrs. Siemens Bros., at £1,975. There were 60 tenders, and there were some lower than that recommended, but they were either not to specification, too light, or were not offering such a high efficiency as the machine recommended.

Bloemfontein.—The contract for the supply of the sub-station equipments, to Messrs. Robert Hammond & Son's specification, consisting of 43 high-tension three-phase panels, 43 low-tension panels and 40 transformers, has been placed with Messrs. J. E. Spagnoletti & Co., of Goldhawk Road, W.

Brighton.—The T.C. on March 15th accepted the tender of the British Westinghouse Electric & Manufacturing Co., Ltd., for work in connection with the air pump motors at the Southwick Works, at £138.

Brush Contracts.—The following contracts have been booked by the Brush Electrical Engineering Co.:—

For the Dublin, Wicklow & Wexford Railway (per Manning & Wardle), two motor coach bodies.
For the South London Electric Supply Corporation, 60-KW. motor-generator.
For Croydon (per British Westinghouse Co.), 15 double-deck tramcar bodies.
For the Great Eastern London Suburban Tramways & Omnibus Co., 10 motor-omnibus bodies.
For Poole Corporation, Parkestone tramways, extension permanent way, overhead line and cables.
For the Gosport & Fareham Tramways Co., three double-deck cars with trucks and Brush motor equipments.
For the Portsdown & Horndean Light Railway Co., two double-deck cars with four-wheel trucks.

Bucharest, Roumania.—The order for the complete electrical equipment for the cotton and bleaching mills being erected by Messrs. Coddington & Lamb has been placed with Messrs. Veritys, Ltd., Manchester.

Croydon.—The Tramways Committee of the T.C. has accepted the tender of the British Westinghouse Electric and Manufacturing Co., Ltd., for 15 double-deck single-truck tramcars, at £7,822.

The T.C. has accepted the tender of Messrs. H. Casperd & Co., of Croydon, for the installation of the electric light at the new fire station.

Gravesend.—The T.C. has accepted the tender of the General Electric Co. for the supply of additional plant for the electricity works, at £2,044.

Hampton.—The U.D.C. has accepted the tender of Messrs. Stuart & Moore for the installation of electric fire alarms, at £326.

London.—PADDINGTON.—The B.C. has accepted the tender of Mr. C. Mickleburgh, at £604, for removing the existing electric lighting installation and supplying and fixing a new one in its stead.

L.C.C.—The Highways Committee of the L.C.C. has received the following tenders for the side-slot rails for the tramways in Kingsland Road:—

Frodingham Iron & Steel Co.	(recommended)	£2,750
Steel, Peech & Tozer		3,641
P. & W. MacLellan		3,640

Estimate, comparable with tenders, £2,915.

The tenders do not include the provision of fishplates. That recommended for acceptance is subject to the approval of the Board of Trade to the adoption of the side-slot conduit system.

The expenditure of £23,168 is to be incurred for the reconstruction and doubling of the existing single line in Goswell Road, between Clerkenwell Road and Ashby Street, and for the execution of the necessary paving works. Messrs. Dick, Kerr & Co., who were recently awarded the contract for the reconstruction of the tramways between Bloomsbury and Poplar, are to carry out this additional work.

WESTMINSTER.—The City Council has accepted the tenders of the following for the annual supply of electrical fittings:—Messrs. G. Angus & Co., H. A. Jackson & Co., London Electric Wire Co., Ltd., Sunbeam Lamp Co., Ltd., United Asbestos Co., Ltd., R. Wood and Co.

POPLAR.—The Lighting Committee has accepted an offer by Messrs. Charles Webster, Ltd., to purchase for £300 an electric crane, which was installed at Bromley depôt in 1901 in connection with the scheme for coal delivery.

HACKNEY.—The B.C. received 11 tenders for the annual supply of coal for the electricity works. The tender of Messrs. Phillips and Co., Ltd., of First Gallery, Coal Exchange, E.C., was accepted for the supply of Butterley fine slack coal, at 9s. 7d. per ton (less 1d. per ton discount), in barge alongside the works.

HAMMERSMITH.—The B.C. has accepted the following tenders for annual supplies in connection with the electricity undertaking:—

Coal (18 tenders), Messrs. William Cory & Sons, Ltd., Crynant or Brynsei, hard dry, large, 14s. 8d. per ton; Powell Duffryn, free burning, large, 16s. 7d. per ton; Wynant, free burning, small, 13s. 3d. per ton; the Crynant Colliery Co., Ltd., Crynant Thro' and Thro', hard dry, small, 12s. 10d. per ton; Crynant, Welsh, small, hard dry, 11s. 1d. per ton; the Main Colliery Co., Ltd., No. 1 Main Thro' and Thro', free burning, small, 14s. 4d. per ton.
Electricity meters, Ferranti, Ltd., 110 volts, 5 amperes, £1 17s. 3d.; 10 amperes, £1 17s. 9d; 15 amperes, £1 17s. 9d; 20 amperes, £2; 25 amperes, £2; 40 amperes, £2 8s. 6d.; 50 amperes, £2 8s. 6d.; 220 volts, 5 amperes, £1 17s. 3d.; 10 amperes, £1 17s. 9d.; 15 amperes, £1 17s. 9d.; 20 amperes, £2; 25 amperes, £2; 40 amperes, £2 8s. 6d.; and 50 amperes, £2 8s. 6d.
Machinery lubricating oils, W. H. Wilcox & Co., £288 6s. 8d.
Packing and jointing material, Messrs. F. Bird & Co., £119 15s. 10d.
Tools, Messrs. J. Gibb & Co., £170 0s. 11d.
Metals, Messrs. F. Bird & Co., £138 13s. 4d.
Gauge glasses, Messrs. J. W. Pimblett & Co., £17 12s. 6d.
Screws, Messrs. F. Bird & Co., £13 16s.
Electrical goods (accessories), the General Electric Co., Ltd., £51 1s. 2d.
Electrical goods (insulating), Messrs, Pryke & Palmer, £64 0s. 1d.
Files, A. B. Bosher & Co., Ltd., £76 10s. 9d.
Oilman's goods, Middleton Bros., £307 6s. 6d.
Insulated wires, W. T. Garnett's Cable Co., £544 11s. 1d.
Fire bricks, clay, lime, &c., Hall & Co., £137.
Arc lamp globes and lamp shades, Mayer & Co., £62 2s.
Brushes and brooms, Messrs. F. Bird & Co., £65 7s. 6d.

Mansfield.—The T.C. has accepted the tender of Messrs. Alley & McLellan for overhauling the two engines at the electricity works, at £200.

Potteries.—The Potteries (Staffs.) Electric Traction Co. have placed an order with the Brush Electrical Engineering Co., Ltd., for the supply of five tramcars, at £800 each.

Sunderland.—The tender of Messrs. Bruce Peebles and Co. for a fourth motor-generator for the Pallion sub-station, and that of the Electrical Co. for switchboard extensions there, have been accepted by the T.C.

Walsall.—The T.C. has accepted the tender of Thomas Parker, Ltd., for two transformers, for £1,430.

Walthamstow.—The U.D.C. has accepted the following tenders for annual supplies of tramway stores:—

Axle brasses, Brush Electrical Engineering Co.
Dash lights, Player & Mitchell.
Brass dust caps, brush-holders, field coils, resistances, Brit. Westinghouse Co.
Axle box covers, axle box spring lids, Brush Electrical Engineering Co.
Gear cases, British Westinghouse Co.
Passenger bells, bell pushes, earth indicator fuses, grab handles, door handles, Player & Mitchell.
Plate glass and indicator glass, Good Bros.
Carbon brushes, General Electric Co.
Bearing springs, spiral truck springs, car wheels, car wheel axles, axle springs, brake blocks, Brush Electrical Engineering Co.
Armature pinions, gear wheels, axle bearings, armature bearings, British Westinghouse Co.
Trolley wheels, standards, heads, poles and pole-springs, trolley head vulcanised brushes, trolley boom sleeves, trolley boom collars, trolley rope, Brecknell, Munro & Rogers.
Trolley head rubber sleeves, coach screws, file card, spring washers, brass washers, leather strip, 1-in. compound strip paper and mica, flax, beast wash leathers, sponges, tools for tower wagon, R. F. Coulston.
Overhead equipment accessories, Brecknell, Munro & Rogers.
Oils, colours, &c., motor axle grease, vaseline, soft soap, J. Bentley & Co.
Rubber for plate glass, cotter pins, panel pins, compound for joint boxes, Asphaltine, Croager Bros.
Tools for tower wagon, &c., R. W. Blackwell & Co.

Whitehaven.—The T.C. has accepted the tender of the General Electric Co. for the ensuing year's supply of electric glow lamps, and that of the Reason Manufacturing Co. for fuse boxes.

FORTHCOMING EVENTS.

To-day's Events (Friday, March 23rd).—At 5 p.m. Physical Society Meeting at University College, Gower Street. Prof. F. T. Trouton on "Unilateral Electric Conductivity over Damp Surfaces." Prof. J. A. Fleming on "The Construction and Use of Oscillation Valves for Rectifying High-Frequency Electric Currents."

At 7.30 p.m. I.E.E. (Manchester Students). Mr. R. C. C. Yates on "Lubrication and Lubricants," and Mr. W. Browning on "Notes on Electrical Conductivity."

Electrical Standardising, Testing and Training Institution. Mr. W. R. Cooper on "Electrical Accumulators." (Lecture II.)

Saturday, March 24th.—At 3 p.m. Royal Institution. Prof. J. J. Thomson on "The Corpuscular Theory of Matter." (Lecture IV.)

Monday, March 26th.—At 8 p.m. Society of Arts. Prof. V. B. Lewes on "Fire, Fire Risks, and Fire Extinction." (Lecture III.)

Tuesday, March 27th.—At 7.30 p.m. I.E.E. (Manchester). Mr. L. J. Hunt on "Alternating Current Motors."

Wednesday, March 28th.—At 7.30 p.m. I.E.E. (Students). Mr. M. G. Tweedie on "Electric Ignition, with special reference to its application to Internal Combustion Engines."

At 8 p.m. Society of Arts. Mr. A. J. Martin on "Coal Conservation, Power Transmission and Smoke Prevention."

Thursday, March 29th.—At 5 p.m. Royal Institution. Prof. B. Hopkinson on "Internal Combustion Engines." (Lecture II.)

At 8 p.m. I.E.E. Extraordinary Meeting. Mr. C. P. Sparks on "Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Co." "Electric Winding Considered Practically and Commercially," by Mr. W. C. Mountain. (Abstract of paper read and discussed at Manchester on January 16th.) Adjourned discussion.

Friday, March 30th.—At 9 p.m. Royal Institution. Prof. P. Zeeman (Amsterdam) on "Recent Progress in Magneto-Optics."

Electrical Standardising, Testing and Training Institution. Mr. J. B. C. Kershaw on "Fuel Economy in Electric Lighting."

At 8 p.m. Electro-Harmonic Society. Last Smoking Concert of the season.

Saturday, March 31st.—At 3 p.m. Royal Institution. Prof. J. J. Thomson on "The Corpuscular Theory of Matter." (Lecture V.)

At 7.30 p.m. Glasgow Technical College Scientific Society. Annual General Meeting.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, March 26th.—"A" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Tuesday, March 27th.—"B" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.; medical examination recruits, 7 p.m.

Wednesday, March 28th.—"A" badge examination for "C" and "D" Companies.

Thursday, March 29th.—"C" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Friday, March 30th.—"D" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.

Saturday, March 31st.—Week-end instruction for "C" Company (Birmingham detachment).

J. H. S. Phillips, Captain E.E.
For O.C.E.E.R.E. (V.).

NOTES.

British Canals.—The subject of canals finds no favour with Mr. Pratt, who writes to the *Times* in criticism of that journal's articles on question. According to Mr. Pratt, the success of Belgian canals is largely due to the fact that Antwerp is the main gateway of Northern Europe, and the canals of Belgium are merely roads for a great deal of traffic that has no connection with the trade of Belgium. The goods carried are merely in transit to Germany or elsewhere, whereas British canals would serve merely local requirements. Mr. Pratt does not explain clearly why the canals did so well before they were grabbed by the railways. He does, however, lay great emphasis on the many locks of our canals, which number on various canals 92 in 32 miles; 58 in 16 miles, including 30 in 3 miles; a staircase of 59 ft. lift, and 45 tunnels from 100 to 3,000 yards. He ignores the fact to which we drew attention in our issue of March 9th, that if the works of a canal are heavy, so, also, must be those of the competing railways. But no one intends to repeat all the little lift locks now existent. Their number would be reduced, or they would be replaced by lifts in place of staircases of locks. It should not be forgotten that every one of the old canals was made by hand labour at great cost. The modern excavator, the dredger and other machines, would make short work of canals much larger than the old ones, and had they to be reconstructed along the old routes, many of the summit levels would be lowered, while the approaches would be carried further forward without locks, and in this way it would be practicable to crowd up half a dozen locks into a short length, and replace them by a lift. This question of mechanical excavation seems quite to have slipped out of mind of those who make so much fuss about locks, and seem to think it impossible to make the canals larger than present sections because of cost. They quite overlook the capacities of the various excavating machines.

In Holland, where canal construction is always more or less in progress, they are very Catholic in their use of excavating machinery, and employ every variety. For extension and deepening of already existing canals dredging is much resorted to, and is a cheap way of removing spoil. It must not be forgotten that there are successful canals other than the two we have specially named. The Weaver navigation is one such canalised river almost wholly artificial, and it is in excellent order, and does a large business. The Aire and Calder navigation is another excellent sample of a successful canal.

But all these successful undertakings are free from railway control, and though railway apologists may say that the railways have not strangled the canals, it is strange that independent undertakings should continue to prosper in spite of the fact that they have been deprived of the support of feeders, and that there is no system in the canals of the country. There can be no system when pieces of what should be a system are connected by narrow lengths capable of taking 20-ton boats only. It is as though the Midland Railway were to attempt a fast service to Manchester with a piece of single track 3-ft. gauge interposed between Luton and Bedford.

The Driver's Yarn.—

Gentle reader, have you ever
In a station been on night watch?
Been on night watch in a station,
Where the load is very steady,
Where the engines are most gracious,
Where the boilers give no trouble,
Worry with the pumps—unheard of,
The condensers never sworn at.
And there really are (or should be)
Stations with such goodly features.
You are, therefore, on the night shift,
And the load is very steady,
All the engines running sweetly,
All the boilers steaming nicely;
Every pump its duty doing,
Each condenser quite reproachless.
Now there is, in many a station,
One (he ofttimes is a driver)
Who of yarns is simply chockful,
For he once was in the Army:
Then, anon, he was a sailor,
Cast away on desert islands,
Nearly eaten up by blackmen,
Almost gobbled by a tiger,
Well nigh vanquished by a lion.
Thus his tales are very thrilling
(And his thirst, it is prodigious),
As the time now passes slowly,
To beguile an odd half hour
You resolve to pay a visit
To old Joe, the grizzled driver,
For he has the reputation,
Of possessing yarns most marvellous;
And there's nothing he likes better,
Than to fondly dwell upon them.
"Rather warm, Joe," you remark
(For it is the height of summer).
"Pretty fair, Sir; pretty fair"
(And you know there's something coming).
"Talk of heat, though, that reminds me
Of a rummy thing wot 'appened
Out in Egypt, where its 'otter
Than the inside of a boiler.
I was with an expedition.
It was when I was a corporal,
In the reg'ment you've 'eard me speak of.
We was marchin' 'cross a dessit.
Talk of 'eat—well it was shockin',
And the sand and wind was chronic,
An' my bloomin' throat was drier
Than an engineerin' tex' book.
Well, Sir, we'd the sun behind us,
And was marchin' easy order.
I 'ad—er—*bought*, the day precedin',
Some eggs from a native village,
And 'ad shoved them in me pannikin,
Which was fastened to me knapsack.
As I said, the heat *was* shockin'.
Well, sir, if you will believe me,
When we 'alted for the night,
Starts to get our suppers ready;
When I opens up me pannikin,
All those eggs was nicely scram ——"
BANG! "Hullo, there goes a breaker!"
Thus abruptly ends his story
(But he got his drink the next day).—B.N.F.

Some Tests of Allis-Chalmers Engines.—In the modern fashion—as some have called it—of using steam turbines in electric supply works, sight must not be lost of what the reciprocating engine can really do. A reminder of this reaches us in the shape of a test of some Allis-Chalmers engines, which appears in full in the pages of our American contemporary, the *Railway and Engineering Review*. The engines in question were of the twin-

cylinder vertical-horizontal engines, fitted with Reynolds-Corliss valves, and running at 75 r.p.m., the rated full load being 7,500 I.H.P. The specification called for a consumption of 12·25 lb. of dry saturated steam at 175 lb. pressure, with a 26-in. vacuum. The actual consumption proved to be 11·96 lb. per I.H.P.-hour, or 17·34 lb. per KW.-hour at the works' switchboard of the purchasers, who were the Interborough Rapid Transit Co. of New York City.

The tests were, however, made under conditions not ideal, as the test load, during the 15 hours, was that provided by the station load. The steam consumed was not taken by weighing the actual amount of steam condensed, but by measuring the boiler feed and correcting for the boiler leakage. The load being anything but constant, the power was determined by tested integrating watt-meters, the readings of which were reduced to I.H.P. by running the generator as a synchronous motor, the electrical input being added to the switchboard readings. Despite all these possible sources of error, pains were taken to make the test authoritative, and the results were regarded as beyond question by the parties chiefly interested. The performance is certainly creditable, and furnishes evidence that, as regards steam consumption, the last word has not been said concerning the possibilities of the reciprocating engine.

Electro-Harmonic Society.—The last smoking concert of the season will be held on Friday next, 30th inst., at 8 p.m., in the King's Hall, Holborn Restaurant. Sir W. H. Preece, K.C.B., F.R.S., will be in the chair. The programme includes songs by Messrs. Harold Wilde and Frederick Ranalow; instrumental music by the orchestra, with a violin concerto by Mr. T. E. Gatehouse; humorous stories by Mr. Valentine Hill; humorous sketches by Mr. Harold Montague; and a ventriloquial sketch by Mr. Frederick Chester.

Institution Notes and Lectures.—ASSOCIATION OF ENGINEERS-IN-CHARGE.—On Saturday last the annual dinner of this Society took place at the Liverpool Street Hotel, Sir A. R. Binnie (President Inst.C.E.) presiding, in the absence through illness of Sir W. H. Preece; a large number of members and friends were present, seats being provided for over 230. After the loyal toasts, Sir A. R. Binnie proposed the toast of "The Association," citing various examples of men who had raised themselves from humble stations to the greatest eminence, and urging the members to work, not for gain only, but for the common good. In reply, Mr. W. T. Hatch, M.Inst.C.E., Past-President of the Association, pointed out that the engineer-in-charge was the real handy man, sometimes having as many as 11 different and simultaneous avocations out of a possible 15. He advised consulting engineers to read papers before the Association, and to pay attention to the comments of the men who had to run the plant.

Proposing "The Chairman of the Evening," Mr. J. Patten Barber, M.Inst.C.E., President of the Association, eulogised the chairman, and commended those who worked bravely year by year without the hope of advancement, doing their best work for the work's sake. Sir A. R. Binnie replied that when he was appointed chief engineer to the L.C.C. he had been warned that he was taking up a very hazardous post, but he had had a very happy time there. He always gave the best advice he could, regardless of the consequences.

Mr. W. C. C. Smith, M.Inst.C.E., past-president, proposed the health of "Kindred Institutions," to which Mr. W. H. Patchell, M.Inst.C.E., vice-president Inst.E.E., responded on behalf of the Electrical Engineers, and Mr. E. G. Rivers, M.Inst.C.E., on behalf of the Civil Engineers.

Mr. T. Aldworth, chairman of the Association, proposed "The Visitors," and Mr. Alderman Smallwood responded; and finally Mr. A. Davey proposed the toast of "The Press," to which Mr. B. A. Raworth replied.

The toasts were interspersed with a musical and humorous programme, under the direction of Mr. G. Hardy, and there was no room for doubting that the members and guests of the Association thoroughly enjoyed themselves.

INSTITUTION OF NAVAL ARCHITECTS.—A paper on the efficiency of Surface Condensers, and one therefore of special interest to electrical engineers, is to be read by Prof. R. L. Weighton before this Institution in the Hall of the Society of Arts, John Street, Adelphi, on April 5th. We are informed that the paper is a record of a very exhaustive series of tests carried out by Prof. Weighton and his staff at the Armstrong College, Newcastle, on the ordinary type of condenser and a new type known as the "Contraflo." The tests have occupied fully a year, and afford an illustration of the influence on engineering progress of research work carried out by technical colleges, especially by the Armstrong College, Newcastle-on-Tyne, which has the largest plant in connection with steam engineering of any college in the world. The results obtained have already attracted considerable attention, as, on account of the influence of vacuum on the steam economy of turbines, any development in surface condensers is of importance both technically and commercially.

Mr. George Hughes, the chief mechanical engineer of the Lancashire and Yorkshire Railway, recently delivered a lecture at the Midland Railway Institute, Derby, on "Some Aspects of Mechanical and Electrical Engineering in America and England in 1905."

At a meeting of the Birmingham Electric Club on 10th inst., a paper on "The Use of Electricity in Mines" was read by Mr. R. G. Mercer.

A lecture on "Electricity in Domestic Service" was delivered at the Edinburgh Merchants' Association meeting last week, by Mr. J. M. M. Munro, F.R.S.E.

Before the Portsmouth Literary and Scientific Society recently, a lecture on "Canada, the Future Electric Manufacturing Power of the World," was read by Major-General Sir John Crease, K.C.B.

At a meeting of the English Ceramic Society held at the Hanley electricity works last Saturday week, Dr. Hutton, of the Electro-Chemical Laboratory, Manchester University, showed a series of experiments illustrating the behaviour of refractory materials when subjected to the intense heating of the electric arc.

NOTTINGHAM GUILD OF MECHANICAL AND ELECTRICAL ENGINEERS.—The ninth annual dinner took place on Tuesday, 13th inst., at the headquarters of the Guild, The Welbeck Hope, Nottingham, Alderman C. Bennett, the President, in the chair. There were about 100 present, including Councillor Tree, Messrs. W. Warner, J. S. Turner, Loughborough; L. W. de Grave, Derby Society of Engineers; Walter Smith, Birmingham; H. E. Newstead and E. Goddard, every branch of engineering being well represented. Letters of apology were read from the Mayor, Alderman Sir J. Tarney, Mr. L. Crosta, Prof. Robinson and others. After the usual loyal toasts, an illuminated address was presented to Mr. J. Carlton, the first secretary and treasurer, as a token of esteem from the members. The chairman, in making the presentation, referred to his strenuous efforts in the early days of the Guild. With commendable brevity, Mr. W. Seals proposed "The Nottingham Guild," and in response, Mr. W. Warner referred to the rapid progress it had made both in numbers and scope, the membership being now something like 170, while the papers submitted and the organised visits made were of great service to engineers generally. The toast of "The President" was given by Mr. F. A. W. Taylor, the secretary, whose energy and courtesy were acknowledged in Alderman Bennett's reply. There was an excellent musical programme which, with the customary toasts, kept the ball rolling merrily till midnight.

ROYAL SOCIETY.—At yesterday afternoon's meeting, the Bakerian lecture was delivered by Prof. John Milne, F.R.S., on "Recent Advances in Seismology." The following papers were to be read:—

Chevalier G. Marconi, "On Methods whereby the Radiation of Electric Waves may be mainly confined to Certain Directions, and whereby the Receptivity of a Receiver may be restricted to Electric Waves emanating from Certain Directions." Communicated by Prof. Fleming, F.R.S.

Prof. J. A. Fleming, F.R.S., "A Note on the Theory of Directive Antennæ or Unsymmetrical Hertzian Oscillators."

Football.—On Saturday last the Bootle Corporation Generating Department met Liverpool Corporation Generating Department at a game of football on Bootle's ground. The score was: Liverpool, 4; Bootle, 3. After the match the Bootle men invited their Liverpool friends to tea and to their second smoking concert of the season. Mr. T. D. Clothier, borough electrical engineer, was elected chairman, and Mr. T. Tucker, of Liverpool Corporation, vice-chairman, they being supported by Mr. J. B. Hudson, deputy electrical engineer, and Mr. E. W. King. The Entertaining Committee, Mr. W. Smith and Mr. C. Mulligan, selected a very pleasing and enjoyable programme, both the Liverpool and Bootle men contributing. In the middle of the programme, refreshments were served.

On Saturday last the annual inter-works match between the employés of the General Electric Co., Witton, and the Robertson Electric Lamps Works, took place on the ground of the latter at Twyford Avenue, Acton. From start to finish the game was of an exciting nature, and although it ended in a victory for the Motorites by 4 to 1, the score hardly represented the game, the Lamp Makers missing fine openings in front of goal. After the game the two teams had dinner at the Clarendon Hotel, Broadway, Hammersmith. The genial manager, Mr. C. Wilson, president of the Lamp Works Club; Mr. E. Wilson, from Witton; Mr. Money, and several others from the London branch of the General Electric Co., were present. The party adjourned to the Lamp Works, where the last dance of the season was held in the spacious hall, beautifully decorated in the colours of the club, and lighted throughout with the "Robertson Wytelite Lamp."

Controlled Torpedoes.—For some time past reports have been appearing in the daily Press as to the performance of a torpedo invented by a M. Lalande, which can be directed and controlled from the shore by Hertzian waves. The idea is old enough, of course; the present reports state that the trials have been successful.

The National Physical Laboratory.—The annual meeting of the general board of the National Physical Laboratory took place at Bushy House on Friday last, March 16th. There were present, in addition to the chairman, Lord Rayleigh, the following among others:—Sir John Wolfe Barry, Mr. Beilby, Mr. Kempe, Mr. R. Kaye Gray, Col. Crompton, Mr. Hadfield, Mr. Gavey, and Mr. Howard.

In opening the proceedings, Lord Rayleigh referred to the great loss the Laboratory had sustained by the deaths of Sir E. Carbutt and Sir B. Samuelson. The report of the Executive Committee for 1905 was presented and approved for presentation to the Royal Society, on the motion of Sir J. Wolfe Barry, seconded by Mr. David Howard. The scheme of work for 1906 was also approved. The report showed progress in all directions. Some 14 scientific papers of importance have been published officially, while members of the staff have contributed nine others to various journals. The second volume of collected papers is in course of preparation. The scheme of work for 1906 includes a research into the resistance of materials of construction to impact; the continuation of the wind pressure and steam researches; the completion of the work with the ampere balance; and some experiments of great interest on the effect of the continued application of high pressure to insulators.

In the metallurgical division a research into the properties of aluminium bronze promises interesting results.

The report announced the intention of the Government, communicated to the Royal Society in December last, to grant a sum of £5,000 for buildings during the year and the increase of the annual grant by £500. It referred also to the very successful meeting in the House of Commons last August, under the chairmanship of Mr. Haldane, which led up to a petition signed by 150 members of the House, asking that the grants should be increased, and the chairman was able to announce that the Chancellor of the Exchequer had recently intimated his intention of making the building grant for the year £10,000 instead of £5,000, as originally contemplated. It was also stated that the Goldsmiths' Co. had very generously made a donation of £1,000 with the request that it should be devoted to some specific object.

The very cordial thanks of the board were voted to the Chancellor of the Exchequer, Mr. Haldane, Sir J. Lawrence, Sir J. Brunner, and the other gentlemen who had interested themselves in the House of Commons petition, and also to the Goldsmiths' Co.

The director gave an account of the proposed additions to the buildings rendered possible by the increased grant, and explained the plans which had been prepared by the Building Committee. The suggestion that the work of erecting these buildings should now be pressed forward, was cordially welcomed, and at a meeting of the Executive Committee held later, power was given to the Building Committee to take the necessary steps.

The board then adjourned to inspect the laboratory, and to view the new electrical buildings. These are now approaching completion. They have been erected by Messrs. Mowlem & Co. at a cost of about £8,000 to the design of Messrs. Mott & Hay, who very kindly gave their services, while with marked generosity Messrs. Mowlem's tender was based on the cost price of the buildings.

It is hoped that they may be opened on June 25th on the occasion of the visit of the foreign guests of the Institution of Electrical Engineers. In view of this ceremony, the invitations on Friday were restricted to members of the board and their personal friends, the usual annual gathering of friends of the laboratory being postponed until June.

A Low-Pressure Turbine on Exhaust Steam.—An interesting installation has recently been put into service at one of the power houses of the Philadelphia Rapid Transit Co. It consists of a low-pressure steam turbine of 800 KW. capacity operating on the exhaust from five Corliss engines aggregating 8,200 nominal horse power. These engines had before been run without condensers on account of an inconvenient water supply. It was determined to supply a condenser and cooling tower, but, instead of utilising the increased available pressure in the engines, to use the energy in the turbine mentioned. The turbine draws its steam supply from the exhaust at a pressure of about 1 lb. above the atmosphere and discharges it into a vacuum averaging about 28 in. Tests of the machine, running on the exhaust of one engine, show a gain from its use of 66⅔ per cent. of the output of the original generating unit, instead of the 25 per cent. usually expected from the introduction of a condenser. These results seem quite remarkable and point to a new, if somewhat limited, field of usefulness for the turbine. If the same advantages can be duplicated elsewhere, it is probable that many plants now operating non-condensing will be anxious to avail themselves of the improvement. The peculiar advantage of the steam turbine in being little affected by moisture in the steam is here a valuable and even necessary quality; and the remarkable efficiency now attained in the use of high pressure steam in turbines makes it easier to believe that the low-pressure machines can be made to give good results. The exact economy in steam consumption in this installation has not yet been fully tested, but it is expected that the specified guarantees of 36 lb. of steam per KW.-hour at full load and 40 lb. at half load with 2 in. absolute back pressure in the condenser will be easily attained; and under these operating conditions such results will be entirely satisfactory.—*Railway and Engineering Review.*

[It should be observed that if the condenser alone had been installed, 20 or 25 per cent. additional power would have been obtained; the addition of the turbine therefore accounts for about 40 per cent. extra power, which must be set against the cost of the turbine.]

Niagara Falls Power Stations.—The capacity, 50,000 H.P., of the first power station erected at the Niagara Falls has now been vastly exceeded. At the present moment six companies are either at work or in course of installation. The three American companies, situated on the right bank, are the Niagara Falls Power Co., the Niagara Falls Hydraulic Power and Manufacturing Co. and the Lower Niagara River Power Co. The first-named company is the initial undertaking, and is an offshoot of the Niagara Cataract Construction Co., formed in 1895. Its two stations are supplied with water from a single tunnel, the older being equipped with 10 5,000-H.P. Fourneyron double turbines, and the new with 11 5,500-H.P. Francis turbines, direct-coupled to 2,400-volt two-phase generators, the current being transformed to 22,000 volts for long distance transmission (to Buffalo, Tonavanda and Lockport, for power purposes chiefly). In 1903 there were connections equal to 80,000 H.P., which have increased since the building of the new station to 110,000 H.P. The undertaking of the second company likewise comprises an old and a new equipment, the former erected in 1896, consisting of 14 double Francis turbines, equal to 33,000 H.P., driving 26 dynamos. The current is supplied for power purposes to local electro-chemical factories, and only a small portion is used for lighting or traction. The new station is in course of building, and will be equipped with 10 8,000-H.P. turbine sets, raising the total capacity of this company when completed to 110,000 H.P. The power station of the third American company is only now in course of erection, and is to be equipped with machinery equal to a capacity of 200,000 H.P. The three Canadian companies situated on the left bank of the Niagara are the Canadian Niagara Power Co., the Ontario Power Co. and the Toronto & Niagara Power Co. The first-named company is financially connected with the first-named American company and its station and equipment were laid out on similar lines. Hitherto, its capacity was 50,000 H.P., the current being generated by five double turbines and direct-coupled dynamos at 12,000 volts, transformed to 22,000, 40,000 or 60,000 volts, for long-distance transmission. The doubling of the present capacity is to be carried out on the same system, so that when completed the company's power stations will produce up to 100,000 H.P. The power stations of the second Canadian company when completed will have an output of 325,000 H.P., generated partly from the Niagara and partly from the Welland River. The Niagara station will be equipped with 11,400 H.P. double Francis turbines, three of which are erected, and 15 are to follow. The third Canadian company contemplates the erection of a plant of a capacity of 125,000 H.P. with a view to supplying power to Toronto, a distance of 74½ miles. The machinery equipment planned consists of 11 12,500 H.P. turbines. When all these companies are at work the total production will equal 970,000 H.P., of which the American companies will supply 420,000 H.P. and the Canadian 550,000 H.P.

Our Oil Supplies.—During the time of the Baku riots many of us who use lighting, lubricating, or power oils, must have wondered how high the prices would go during the coming time of shortage. That there would be scarcity, and that in the natural course prices would rise seemed certain. Owners of oil engines would be particularly affected, and the demonstration of instability in the price of fuel might lead to a check in the encouraging sales of the heavy engines which are becoming so familiar.

Perhaps those who are concerned intimately in the production and sale of oils have not been surprised to find that, as a fact, those prognostications have not been fulfilled in any considerable degree; probably outsiders, including the majority of consumers, have been agreeably astonished.

For a short time prices were raised, except, of course, to those who were lucky enough to have contracted well ahead, but to nothing like the extent, and for nothing like the period, anyone might be excused for expecting.

The Commercial Supplement of the *Times* for March 19th has some figures on the subject, and it is evident that although the damage to plant at Baku was enormous, the amount of Russian oil in store at the time was so great as to act as an "accumulator" to the trade, while the slight out-balance of prices made it worth America's while to pour into the European market almost enough to square the total imports of 1905 with those of 1904.

If an unparalleled disturbance, such as the Baku revolution, cannot effect our oil markets more than that, the users of oil fuel need feel no alarm for the future, and when they understand that the quantity of oil in sight is ever on the increase, their fears may be calmed still more.

New oil fields have been developed in America which will do more than compensate for the drying up of the Pennsylvania field, and, to quote from the *Times* Supplement, "it may not be generally known that petroleum has been discovered in Turkestan . . . . and that Sumatra, Java and Borneo are now important contributors to the world's supplies, as well as Burma and Assam. Oil is known to exist in several parts of Japan, which in 1904 yielded 60 million gals., and it is believed to exist in several parts of South Africa. In Europe there are large fields in Galicia, Roumania and the Carpathians." More than that, there are immense tracts of country like China and South America, of which the oil-bearing capacity is unknown.

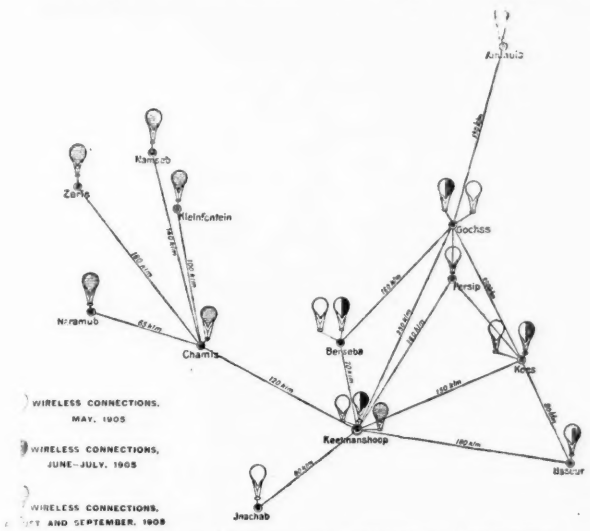
In view of these facts, no one need hesitate to put down oil-burning plant for fear of prices becoming prohibitive within the next 10 years.

Electrolytic Deposition of Lithium.—Since the preparation of metallic calcium on an industrial scale has become an accomplished fact, it is not surprising that other depositions of a similar nature should come within the range of the investigator. The latest development in this direction is the production of the metal lithium in a pure state for the first time. Numerous attempts have been made previously to prepare this substance by the electrolysis of its fused salts, but the difficulties have been insurmountable. The product has always been impure or the method too costly to be of use. For this latest achievement we are indebted to O'Ruff and O'Johansen, who used a mixture of 90 per cent. of lithium bromide and 10 per cent. of lithium chloride, both of which salts may be obtained pure from the hydroxide. The electrolysis was conducted in a Muthmann's appartus made of copper between a gas carbon anode and two iron cathodes placed side by side. An E.M.F. of 10 volts was used, and a current of 100 amperes, which was sufficient to keep the whole mass melted. The lithium which floats on the surface in a molten condition, was removed in a iron spoon from time to time and allowed to solidify on stone slabs. The product contained 0·17 per cent. of sodium, but was otherwise pure. The melting point of the metal has been redetermined and found to be 180° C. The total yield was 80 per cent. of the current used.

(*Continued on page* 477.)

WIRELESS TELEGRAPHY IN GERMAN SOUTH-WEST AFRICA.

The most up-to-date method of transmitting information in time of war is wireless telegraphy, which, though of quite recent origin, has now reached such a stage of development


Kamjab
Zesfontein
Kleinfontein
Nomtsas
Nomtsas
Nomtsas

a partition, and carries the sending and receiving apparatus. In the forward section, guarded against personal contact, are placed

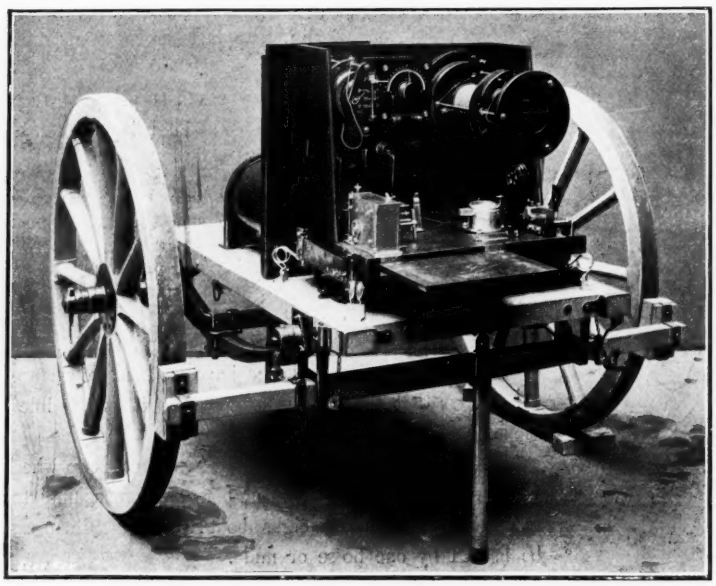


Fig. 3.—Portable Transmitting and Receiving Station; Military Wireless Telegraph Equipment.

the high-pressure apparatus: the induction coil, the Leyden battery with variable multiple sub-divided spark-gap, and the high-pressure transformer. These are readily accessible through a movable trap door in the side of the cover, so as to facilitate the changing of the jars and spark gap. In the hinder section are fixed the Morse key, and on a spring-carried board two receivers and a recorder, together with a small receiving transformer. On the partition is mounted the large receiving transformer, the coherer, and a counter-capacity two-way change-over switch. On the side wall is the electrolytic detector and telephone receiving apparatus, and a light portable call-bell is provided. The cover can be removed without interfering with any of the electrical connections, the storage battery for the lamps, which are mounted on the cover, being fixed in a box on the side of the latter.

The gas-holders and the necessary tools, as well as the balloons and a reserve store of benzine, are carried on the third car. The gas-holders are built into the car, and each holds about 5 m^3 at 120 atmospheres. Two holders suffice for filling one balloon.

The aggregate crew of the three stations includes four officers, four non-commissioned officers and 27 men.

Though the haste in organising these first wireless telegraph stations did not admit of any previous training of the crew, a permanent connection was nevertheless maintained between the various detachments. Recording telegraphs were used for the transmission of information to distances up to about 100 km., whereas telephones were resorted to (for an acoustical reception of the Morse signals) for greater distances up to 150 km. The latter method was exclusively adopted later on. The aerial wires could not always be raised to a height corresponding to their length, the balloon drift being mostly too small, owing to the considerable altitude of the ground above the level of the sea, which obviously decreased the range of the stations. Other unfavourable factors were the dryness of the air and the frequent occurrence of thunderstorms, while the balloons were sometimes torn off by whirlwinds. The balloons, moreover, were a frequent mark for the projectiles of the enemy. The working of the wireless service was nevertheless so satisfactory that three further stations were installed at the end of last year.

A permanent connection was established in the course of last summer between Aminius and Keetmanshoop (about 450 km.) by means of four intermediate stations, while another permanent connection has been effected between Hasuur and Keetmanshoop (180 km.) without any intermediate posts. Immediate communication has been frequently obtained between places up to 340 km. distant.

Though the success obtained by this service was partly due to the fact that the enemy was not equipped with any similar outfit, the experience gained in connection with the South-West African war would seem definitely to evidence the value of this means of communication in warfare.

THE SHAWINIGAN WATER AND POWER CO.

The works of this company are situated at Shawinigan Falls, Province of Quebec, and lie about half way between

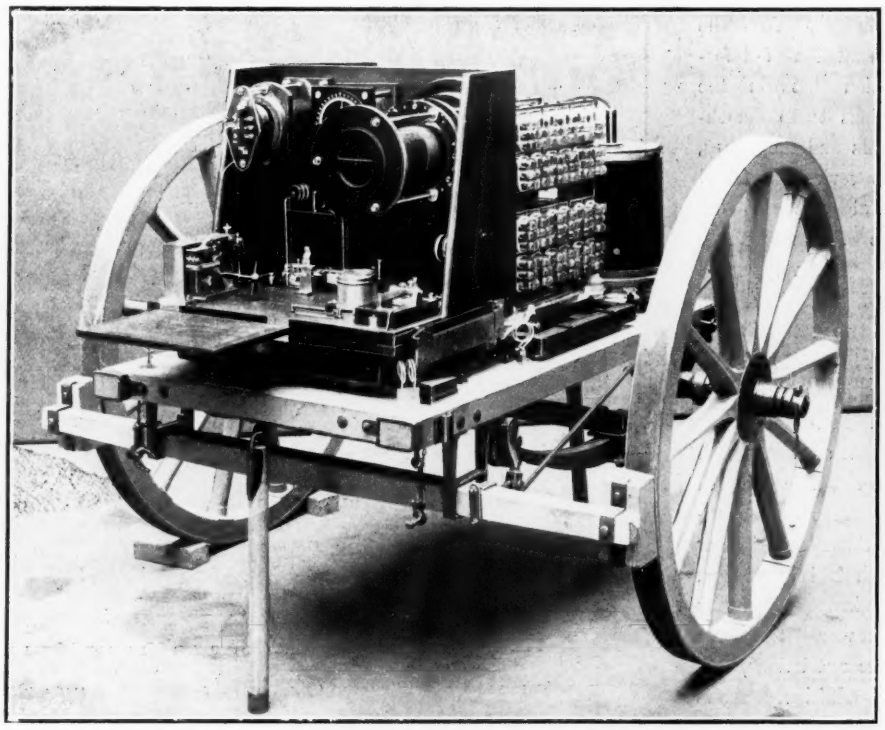


Fig. 4.—Transmitting and Receiving Equipment Showing the Leyden Battery, &c.

the cities of Montreal and Quebec. The works are noted for having the longest transmission line in Canada, deliver-

ing current generated at Shawinigan Falls to a terminal station in Montreal over a distance of 90 miles, and at a pressure of 50,000 volts.

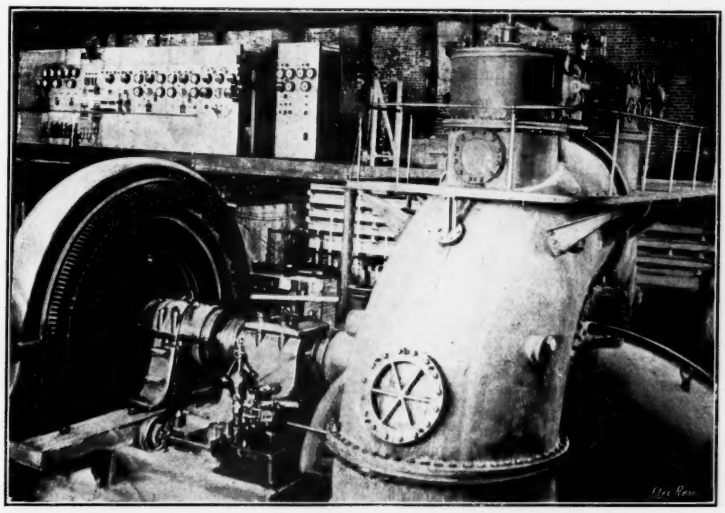
Shawinigan Falls is a cascade in the St. Maurice River, which here descends some 145 ft., and this water power and surrounding lands were purchased from the Government of Quebec by the company.

The source of the river is about 400 miles north of the Falls, and along its whole course the country is thickly timbered and studded with lakes, so that the flow of the river is very constant during the whole year, and it is estimated that at minimum low water mark, the Falls will admit of the development of 125,000 H.P., although eventually it is proposed to further increase this by building a dam 15 ft. high at the crest of the Falls, thus increasing the available head.

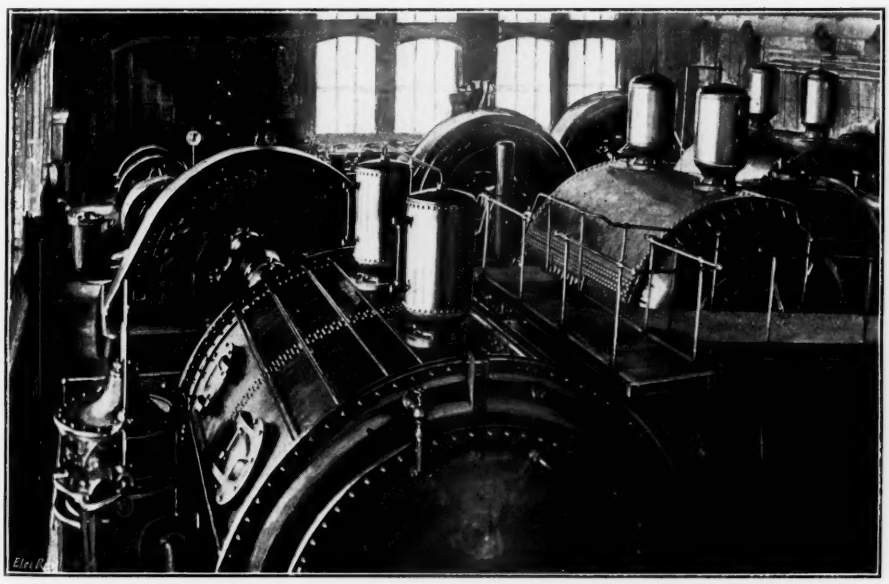
The Falls are admirably situated for the development of water power, and offered no engineering difficulty.

Just above them and for a distance of 5 miles, the river spreads out forming a large lake. From this point the water flows round a spur into a similar lake, thus allowing a comparatively short run for the penstocks. Work was commenced on the plant in 1900, and a local supply was started the following year. In 1902 arrangements were concluded with the Montreal Light, Heat and Power Co. to give a supply, and its transmission was begun the following spring.

The water is diverted from just above the Falls through a canal 900 ft. long and 90 ft. wide, with an average depth of 25 ft., to the gatehouse. This canal was cut out of the solid rock, and its formation was decided on so as to minimise, as far as possible, ice troubles, as great quantities of ice come down the river during the spring.

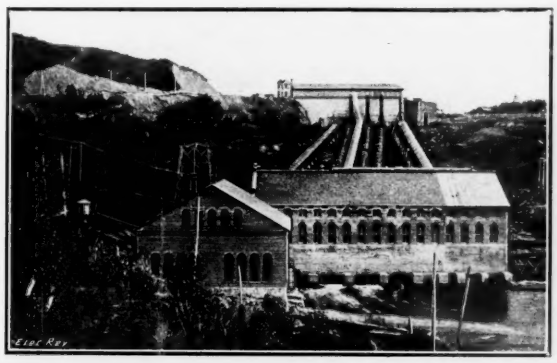


View of the Morris-Westinghouse 10,500-H.P. 6,600-kw. Generator.



View of the Horizontal 3,750-kw. Turbo-Generators.

The gatehouse consists of a concrete dam with openings for seven penstocks, the openings being guarded by ice racks. The dam is surmounted by a brick building which



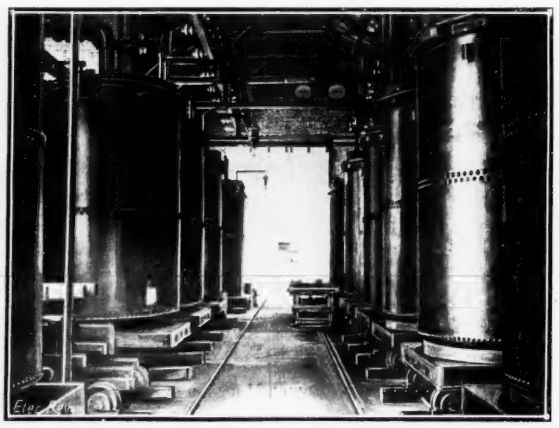
View of the Shawinigan Power House, showing the Penstocks.

contains the hydraulic machinery, working at a pressure of 800 lb. per sq. in., for raising or lowering the gates at the upper ends of the penstocks. There are now five penstocks in operation to the power station, three being of 9 ft. diameter, one 12 ft., and one 3 ft. 6 in. diameter. These are built of $\frac{3}{8}$ in. boiler plate, and are fitted with stand pipes instead of relief valves; they enter the station at the floor level, a heavy thrust flange being imbedded in the concrete wall at the point where each penstock enters the building. The length of each penstock is about 480 ft.

The power house is built on solid rock, and is situated just above the level of the lake below the falls. The rock was blasted to a depth of several feet below the level of the lake to provide for the tail races and the proper sealing of the draught tubes of the turbines. The building, which measures 170 ft. × 70 ft., is of solid concrete construction up to the windows, the upper walls being of brick. The roof is of fire-proof construction. The whole building is served by a 50-ton electrically operated crane.

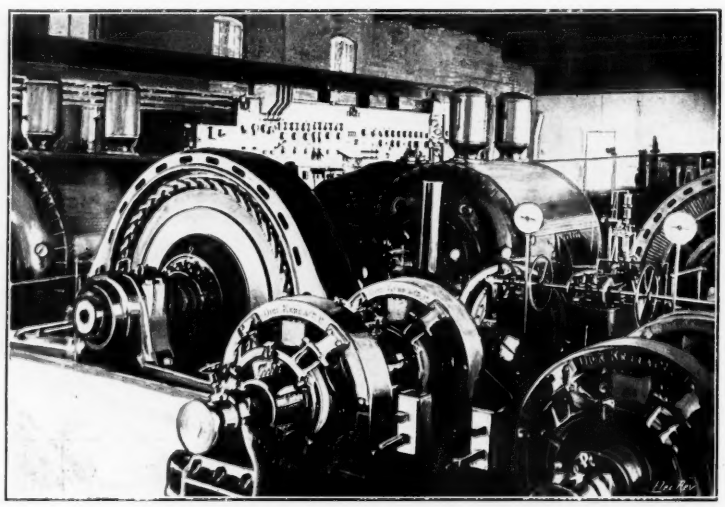
The present plans provide for 75,000 H.P., towards which there are now installed four units, having a total of 28,500 H.P.

Two of the 9-ft. penstocks are direct connected to turbines of the horizontal type, each of which consists of a pair of Francis inward-discharge wheels in a steel case,



View in the Transformer House.

running at 180 r.p.m., and capable of developing 6,000 H.P. These sets were built by the I. P. Morris Co., of Philadelphia. They have no gates on the high pressure side, but are controlled by butterfly valves in the draught tube, the valves being regulated by a Lombard governor. Each of these turbines is direct coupled to a Westinghouse alternator of the revolving field type, having a capacity of 3,750 KW. and generating two-phase current at 2,200 volts pressure and 30 cycles.



The 3,750-KW. Generators and Exciters.

The third 9-ft. penstock is also connected to a turbine of the horizontal type, built by Escher, Wyss & Co., of Zurich, which is similar to the previous ones except that it has gates on the high pressure side which are regulated by a hydraulic governor driven by a centrifugal pump. The generator in this case was built by Messrs. Dick, Kerr & Co., of London, and is of similar size to the Westinghouse machines.

The 12-ft. penstock serves a single wheel built by the I. P. Morris Co. This is of the outward discharge type. The runner is 7 ft. in diameter, and the machine has a capacity of 10,500 H.P. When developing this power it passes 26 cm. of water per second, the water discharging into two draught tubes. Movable gates are provided on the high-pressure side, regulated by a hydraulic governor working at penstock pressure. This wheel is direct coupled to a Westinghouse alternator similar to those already described, except that it has a capacity of 6,600 KW. Another similar set is shortly to be installed, the present plant being worked up to its full capacity ; each machine is capable of doing a continuous overload of 25 per cent.

The smaller 3 ft. 6 in. penstock is branched in the power house, the two branches being each coupled to a 500-H.P. wheel, driving a shaft to which are coupled two D.C. dynamos, built by Messrs. Dick, Kerr & Co. Each of the machines has a capacity of 150 KW. at a pressure of 120 volts, and they can be run in parallel, or used separately. One of the complete sets is used for exciting the generators, and the other for driving the station motors. Energy from these sets is conveyed on aluminium bus-bars to the exciter panels, located on a gallery which runs nearly the entire length of the building. At one end, and underneath this gallery, are placed the electrically operated oil switches and the alternating current bus-bars.

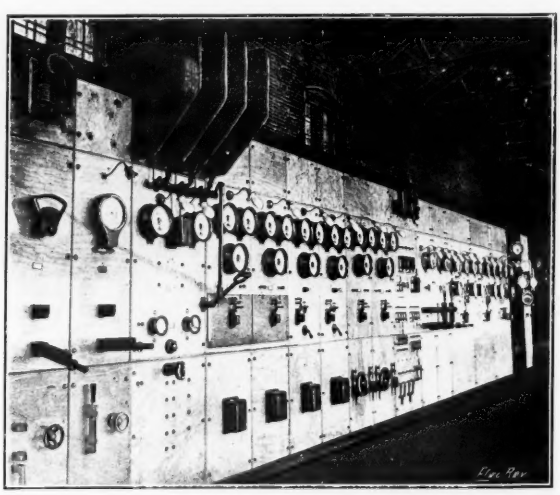
Mounted on the switchboard gallery are the panels for the station circuits, exciters and the operating panels for the generators and feeders ; each panel being fitted with the usual instruments. The oil-break switches and the rotor circuits and rheostats on the generators are electrically operated.

Energy is conducted from the generators by paper-insulated lead-covered cables to the generator switches, which are of the solenoid type, and work very rapidly ; it is then conducted to two knife selector switches, by means of which the supply can be thrown on to either one of the two sets of bus-bars. All cables in the power house are laid separately in fireproof conduits, so that in case of one cable burning out, the others would not be injured.

For local small power use, the supply is taken from the bus-bars through a circuit-breaker to a lightning-arrester house, and thence on overhead lines to the point of use.

For larger local factories the supply is taken through an oil-break switch to transformers which step up the pressure to 25,000 volts, and it is then distributed along overhead lines. Factories taking a supply at this pressure have their own step-down transformers for reducing the pressure to 70 volts, the current being used for the manufacture of calcium carbide and manganese.

The supply for longer distances, such as to Montreal and intermediate towns, is taken from the bus-bars through oil switches to Scott connected transformers, for stepping up to 50,000 volts three-phase, thence through static interrupters and lightning arresters to two sets of overhead lines which



The Main Switchboard : Shawinigan.

terminate in a sub-station at Maissoneuve, Montreal ; from this point energy is distributed at different periodicities and pressures to several power and street railway companies.

(To be concluded.)

NOTES.

(*Concluded from page 472.*)

Water-power in Switzerland.—It is calculated that in the course of a few years the Aluminium Industry Co., of Neuhausen, will have about 85,000 H.P. available for use, as the company already obtains 25,000 H.P. from its three works, and large extensions are in progress. These latter comprise the utilisation of the waters of the Rhone and the Navigence, which are to be led separately by tunnels and mains to a point near Chippis, in the neighbourhood of the Sierre station, where two turbine plants are to be installed for the concentration of the resulting 50,000 H.P. in a single works. The Navigence scheme, which is the first to be carried out, has been arranged for under contracts, whereby the firm of Escher, Wyss & Co. will deal with the double pipe line and turbine installation comprising ten units, yielding a minimum of 25,000 H.P., while the electrical generators, &c., will be furnished by the Oerlikon Machine Works and the General Electricity Co., of Berlin. It is proposed to follow with the Rhone scheme in the summer, and it is expected that the power realised will be approximately the same as in the preceding project, and in both cases the cost of the power will be very low. The third extension relates to the utilisation of the Rheinau, which will yield about 10,000 H.P., although the cost per H.P. will probably be higher than in either of the former cases. It is also intended to carry out this scheme at an early date.

A German Mercury Vapour Lamp.—The Quarz Lampen Gesellschaft is the title of a new company which has been formed in Berlin, and in which the Allgemeine Electricitäts Gesellschaft and the firm of W. C. Heraus, of Hanau, are interested. The company takes over the patents of Dr. Kuch, of the Hanau firm in question, relating to a mercury lamp which, according to the official statement, represents a material improvement over the already known mercury vapour lamp, from which it differs in being made of pure quartz and not glass. It is claimed that the advantage of the invention lies in the economy realised and in the possibility of manufacturing the lamps for all ordinary pressures up to 500 volts and of being able to place them everywhere singly in circuit; whilst at the same time the lamps require but little attention, as carbons are not used and the wearing out of the part to be replaced does not take place under 1,000 working hours. It is therefore submitted that the lamp will prove in many cases to be the substitute that has long been desired for arc lamps. As against this statement a technical correspondent of the Berlin *Tageblatt* remarks that the lamp is not new and that it was improved by the Hanau firm in continuation of the investigations which were begun by Dr. Arons in Berlin over 10 years ago. The lamp, he declares, is not applicable as a source of light, but rather as a means of production for the so-called short wave action rays, that is, for chemical and physiological purposes. It gives a cold violet light; of more importance are the ultra-violet rays emitted by it, which are not seen but which are of considerable effect upon the human skin and upon the production of numerous chemical reactions. The rays proceed from the mercury vapour which is enclosed in a tube, and through which passes an electric current. The tube is made of quartz or, as Herr Schott, of Jena, has shown, from special kinds of glass, as ordinary glass absorbs the most effective rays and would retain them in the lamp. The correspondent in conclusion states that it cannot yet be judged whether the lamp will find technical application on a large scale.

London and Electric Power.—Several of the great railway companies and other large undertakings are anxious lest the Government shall not allow the electric power Bill known as the St. Neots scheme to be proceeded with. It is said that members of the Government are divided on the question. Mr. Asquith and Mr. Haldane hold that it would be only fair to allow the Bill to proceed, but Mr. John Burns is strenuously opposed to it. The reason for this opposition is that the Bill clashes with the electric power Bill of the London County Council. Thus the dispute is really one of private enterprise as opposed to municipal trading. The opposition of the municipal traders is strong, because it is feared that the St. Neots scheme would be a damaging rival to that of the London County Council.—*Standard.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Central Station Engineers.—At a special meeting of the Hackney B.C., on March 15th, the following scale of minimum and maximum salaries in the electricity department was adopted:—Borough electrical engineer, minimum £450 per annum, increase bien. £25, maximum £750; distributing engineer, £200, £12 10s., £325; works superintendent, £150, £10, £200.

On Monday last week the electrical staff of the Lanarkshire Steel Works presented Mr. M'Donald, late electrician, with a dressing case on the occasion of his leaving for Canada.

The staff of the Loughborough Corporation Electricity Work sat down to dinner together on 14th inst. in the workshop, which had been artistically decorated for the occasion. The company numbered 14, Mr. W. H. Allen (electrical engineer) presided, and Alderman A. A. Bumpus (chairman of the committee) was the guest of the evening. The menu included "Boiler Fluid," "Stripped Turbo Blades" and "Filtered Oil," and many other appropriate dishes. After the loyal toasts, Mr. Allen proposed "The Committee," to which Alderman Bumpus responded, and the Alderman submitted "The Undertaking." "The Consumers" was proposed by Mr. Merry and acknowledged by Mr. Hall.

At a complimentary smoking concert held at the Napier Hotel, Sheerness, on Monday evening last, Mr. H. J. Nisbett was presented with a case of pipes, also a rose bowl for Mrs. Nisbett, as a token of the esteem and respect in which he has been held by the staff and employés of the Sheerness tramways during the time he has been managing engineer at Sheerness. Mr. A. A. Watkins, late managing engineer at Lewes, who succeeds Mr. Nisbett, made the presentation.

General.—Dr. W. M. Thornton has been appointed to the newly created professorship of Electrical Engineering at the Armstrong College, Newcastle. He has been head of the electrical engineering department of the Armstrong College for seven years.

The New York correspondent of the *Daily Mail* recently stated that Mr. Bonar Law had become chairman of the British Westinghouse Co.

Mr. Theodore Rich, A.M.I.C.E., has resigned his appointment in the Sudan Government service, and has returned to London. His address will be for the present 104, St. George's Square, S.W.

Mr. George Lister, the sole British agent for Messrs. W. T. C. Macallen & Co. has just gone for a business trip to the States to go over Messrs. Macallen's works, and to discuss business generally with them. On his return he will have a full range of tramway requisites to place before the tramway industry.

Mr. H. N. Howlett, A.I.E.E., asks us to announce that he has resigned his position with Mr. G. Braulik to join the firm of Messrs. G. Straus & Co., Ltd., 211, Upper Thames Street, E.C., and will give special attention to "flame" arc lamps and meters.

A silver coffee service has been sent out to Mr. A. E. Gibbs, the newly-appointed distribution engineer, Johannesburg Lighting and Tramways Undertaking, from the staff of Messrs. W. T. Glover and Co., Ltd. The directors further sent Mr. Gibbs a mahogany chiming clock in appreciation of his 9½ years' service with the firm.

Mr. R. W. Gauntlett has resigned his position as West of England representative for the British Westinghouse Co. and joined the staff of Messrs. Bruce Peebles & Co., Ltd., whose representative he will be in the above district, and also in London, the Southern, South-Eastern and Eastern Counties.

Mr. A. W. W. Horsbrugh has resigned his position in the drawing office of Messrs. Lionel Robinson & Co., Ltd., Thames Ditton, to take up the duties of chief engineer and assistant manager on a plantation of the Assam Tea Co., India.

NEW COMPANIES REGISTERED.

Wilson-Wolf Engineering Co., Ltd. (87,897).—This company was registered on March 8th, with a capital of £3,000 in £1 shares, to carry on the business of electrical, mechanical and general engineers, coppersmiths, machinists, ironmongers, constructors of electrical tramcars, motor-cars, carriages, cycles and other vehicles, manufacturers of and dealers in electric light cables, telegraph and other wires and accessories, dynamos, motors, telephones, bells, electroliers, arc and other lamps and fittings, &c. The first subscribers (each with one share) are:—J. H. Wilson, Easthorpe House, Mirfield, railway contractor; Mrs. S. Wilson, Easthorpe House, Mirfield; R. Wolf, 10, Parkfield Road, Bradford, cigar manufacturer; Mrs. M. Wolf, The Elms, Parkfield Road, Bradford; H. Wilson, Easthorpe House, Mirfield, electrical engineer; L. J. Wolf, 10, Parkfield Road, Bradford, electrical engineer; and H. Wolf, 10, Parkfield Road, Bradford, cigar manufacturer. No initial public issue. The number of directors is not to be less than two nor more than seven; the first are J. H. Wilson, R. Wolf, H. Wilson and L. J. Wolf; qualification, 50 shares; remuneration as fixed by the company. Voting powers, one vote for every 10 ordinary shares, and 10 votes for each deferred share. (The original capital is stated to consist entirely of ordinary shares.) Registered office, Laycock's Mill, Thornton Road, Bradford.

Improved Electric Traction, Ltd. (87,822).—This company was registered on March 3rd, with a capital of £15,000 in £1 shares, to acquire on the terms of an agreement with W. Roberts, certain contracts and properties, and to carry on the business of proprietors and manufacturers of motors, motor-cars, carriages and vehicles (whether worked by electrical or other power), engineers, electricians, &c. The first subscribers (each with one share) are:—J. Neely, 60, Coleman Street, E.C., solicitor; E. Reilly, 16, Oliver Avenue, South Norwood, S.E., clerk; L. J. Welham, 3, Buckingham Road, Stratford, E., clerk; W. H. Evans, 124, Barnsbury Road, N., clerk; R. C. Kerr, 60, Coleman Street, E.C., solicitor; R. F. Light, 92, Palatine Road, Stoke Newington, N., clerk; and H. G. Hazelgrove, 15, Palace Road, Upper Norwood, S.E., clerk. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are to be appointed by the subscribers; qualification, £500; remuneration as fixed at statutory meeting. Registered office, 60, Coleman Street, E.C.

Cope-Collis Syndicate, Ltd. (87,870).—This company was registered on March 7th, with a capital of £10,000 in £1 shares, to acquire from W. Cope the benefit of certain existing inventions relating to electric shallow tramway conduits, and to develop and turn to account the same. The first subscribers (each with one share) are:—E. Simons, 19, Sunnyside Road, Ealing, tutor; H. T. Brickwell, 12, Pall Mall, S.W., theatrical proprietor; J. Chapman, St. Mary's Road, Ealing, school proprietor; J. F. Webb, 16A, Wirtemberg Street, Clapham, engineer; Annie Brickwell, 101, Brixton Road, S.W., vocalist; E. Kenyon-Collis, 12, Pall Mall, S.W., insurance broker; and Gertrude Chapman, The Owls, Ealing, private secretary. Minimum cash subscription, £7. Registered without articles of association. The first directors are E. Simons, H. T. Brickwell, J. Chapman, J. F. Webb, Annie Brickwell, E. Kenyon-Collis and Gertrude Chapman. Registered office, 12 Pall Mall, S.W.

Electric Sweetmeats, Ltd. (87,873).—This company was registered on March 7th, with a capital of £20,000 in £1 shares, to acquire the interest of the British Pure Sweet Co., Ltd., and J. L. de Moville, in "Fairy Floss Candy," and the process for manufacturing the same or any fibrous or silk candy by electricity or otherwise. The first subscribers (each with one share) are:—W. R. Ashworth, 10, Norfolk Street, Manchester, sharebroker; R. H. Mabbott, Claremont, Blackpool, caterer; W. R. Elliston, 135, Clowes Street, Lower Broughton, Manchester, manager; L. L. Samuels, 7, Norfolk Street, Manchester, chartered accountant; F. Youatt, 7, Norfolk Street, Manchester, chartered accountant; A. Chappell, 13, Birkhead Street, Heckmondwike, clerk, and J. Duckworth, 10, Norfolk Street, Manchester, sharebroker. Minimum cash subscription, 500 shares; the number of directors is not to be less than three or more than seven; the subscribers are to appoint the first; qualification, £1; remuneration as fixed by the company.

Zedecco Batteries, Ltd. (88,012).—This company was registered on March 16th, with a capital of £2,505 in 2,500 "A" shares of £1 each and 200 "B" shares of 6d. each, to acquire certain existing inventions relating to galvanic cells known as "Zedecco Accumulator," to adopt an agreement with A. L. Lambert, and to carry on the business of electricians, engineers, manufacturers of and dealers in electric batteries, suppliers of electricity, &c. The first subscribers (each with one share) are:—L. E. Chafniag, 67, Folmer Road, Fulham, S.W., merchant; W. Skinner, 6, Throgmorton Avenue, E.C., secretary; H. A. Kidd, 6, Throgmorton Avenue, E.C., accountant; A. Ireland, 58, Blenheim Road, Walthamstow, clerk; T. Greenhill, 7, Tanza Road, Hampstead, N.W., director; Minnie Tromm, 66, Cricketfield Road, Lower Clapton, N.E., typist; and H. H. Syms, 70, Queen Victoria Street, E.C., solicitor. No initial public issue. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification, one share. Registered office, 6, Throgmorton Avenue, E.C.

Punjaub Electric Traction Co., Ltd. (87,987).—This company was registered on March 15th, with a capital of £5,000 in 4,991 shares of £1 each, and 180 shares of 1s. each, to carry on in India or elsewhere the business of tramway, railway, omnibus and van proprietors, carriers of passengers and goods, suppliers of electricity for light, heat, motive power and other purposes, &c. The first subscribers (each with one share) are:—H. P. Dakin, 130, Homesdale Road, South Norwood, S.E., clerk; R. J. Muggleton, 14, St. Helen's Place, E.C., clerk; W. A. Hill, 1, Colwell Road, East Dulwich, S.E., shorthand writer; R. G. Cheshire, 14, St. Helen's Place, E.C., clerk; A. G. Coggan, 14, St. Helen's Place, E.C., clerk; W. J. Hill, 14, St. Helen's Place, E.C., clerk; and H. Fraser, 14, St. Helen's Place, E.C., solicitor. No initial public issue. The number of directors is not to be more than five; the subscribers are to appoint the first.

British Automatic Telephone Syndicate, Ltd. (87,976).—This company was registered on March 15th, with a capital of £40,000 in £1 shares, with objects as indicated by the title. The first subscribers (each with one share) are:—W. O. MacBride, Range House, Shepperton, stockbroker; P. Wood, 115, Castlenau, Barnes, S.W., manufacturer; C. J. Avery, Dashwood House, E.C., secretary; J. Thompson, 10, Finsbury Circus, E.C., clerk; C. W. Heavers, 10, Finsbury Circus, E.C., clerk; C. J. Brayshaw, 10, Finsbury Circus, E.C., solicitor; and B. G. Reid, 55, Sandmere Road, Clapham, clerk. No initial public issue. The number of directors is not to be less than three or more than five; the subscribers are to appoint the first; remuneration, £100 each per annum (chairman £150) and 5 per cent. of the distributed profits divisible. Registered office, 151-153, Dashwood House, New Broad Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Typewriting Telegraph Corporation, Ltd. (66,332).—This company's annual return was filed on January 18th, when 69,833 shares (exclusive of 1,167 forfeited) had been taken up out of a nominal capital of £100,000 in £1 shares. £1 per share has been called up on 25,533 shares, resulting in the receipt of £25,872 17s. 6d., including £339 17s. 6d. paid on the said forfeited shares. 44,300 shares are considered as fully paid. Mortgages and charges: £740.

Llangollen and District Electric Light and Power, Ltd. (75,384).—An agreement for further charge, dated February 23rd, 1906 (endorsed on debenture dated February 4th, 1905), to secure £600, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: S. L. Jones, Glanrafon, Llangollen.

Morley Electrical Engineering Co., Ltd. (52,358).—This company's annual return was filed on February 17th, when 1,524 shares had been taken up out of a nominal capital of £5,000 in £1 shares. £504 has been received and £1,020 is considered as paid. Mortgages and charges: £1,000.

Mexican Electric Works, Ltd. (in liquidation) (52,281).—This company's annual return was filed on January 4th, when the entire capital of £400,000 in 80,000 shares of £5 each had been taken up and paid for in full. Mortgages and charges: Nil. (Resolution to wind up voluntarily passed on December 20th, 1905, at a meeting held at Montreal, Canada.)

Lancashire Electrical Engineering Co., Ltd. (56,992).—This company's annual return, made up to May 6th, 1905, was filed on December 31st, when 1,883 shares had been taken up out of a nominal capital of £5,000 in 5,000 shares of £1 each. £50 has been paid and £1,833 is considered as paid. Mortgages and charges: Nil.

Typewriting Telegraph Corporation, Ltd. (66,332).—Issue, on February 16th, of £410 10 per cent. debentures, part of series created November 14th, 1904, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £740.

Telephone Co. of Egypt, Ltd. (17,824).—An acknowledgment of indebtedness, dated February 21st, 1906, to secure a further £40,000 debenture stock (supplemental to a trust deed dated July 27th, 1904, securing £60,000 debenture stock), has been registered. Property charged: The company's undertaking and property, present and future, except uncalled capital. Trustees: Sir Auckland Colvin, K.C.S.I., Earl Soham Lodge, Framlingham, Suffolk; and G. F. Braithwaite, Kendal, Westmorland.

Europe and Azores Telegraph Co., Ltd. (39,452).—This company's annual return was filed on February 9th, when 18,146 shares had been taken up out of a nominal capital of £200,000 in 20,000 shares of £10 each. £10 per share has been called up on 12,578, resulting in the receipt of £125,780. £55,680 is considered as paid on 5,568 shares. Mortgages and charges: Nil.

General Electric Inspection Co., Ltd. (75,833).—This company's annual return was filed on February 15th, when 1,907 shares had been taken up out of a nominal capital of £10,000 in £1 shares. £7 has been received and £1,900 is considered as paid. Mortgages and charges: Nil.

Anglo-American Telegraph Co., Ltd. (2,891 C).—This company's annual return was filed on March 1st, when the entire capital of £7,000,000 in £634,500 Consolidated ordinary, £3,182,750 preferred ordinary and £3,182,750 deferred ordinary stock had been issued and paid up in full. Mortgages and charges: Nil.

Universal Telephone and Electrical Co., Ltd. (68,317).—This company's annual return was filed on February 23rd, when 400 £5 and 400 £1 shares had been taken up out of a nominal capital of £10,400 in 2,000 ordinary shares of £5 each, and 400 founders' shares of £1 each. £2 10s. per share has been called up on the £5 shares and £1,000 has been received. The £1 shares are considered as fully paid. Mortgages and charges: Nil.

Westinghouse Electric Co., Ltd. (29,334).—This company's annual return, made up to December 31st last, was filed on February 1st, when 18,955 preference and 27,500 ordinary shares had been taken up out of a nominal capital of £600,000 in 30,000 preference and 30,000 ordinary shares of £10 each. £10 per share has been called up on 3,155 preference and £31,550 has been received. £433,000 is considered as paid on 15,800 preference and 27,500 ordinary. Mortgages and charges: Nil. Mr. P. F. Kobbé resigned his seat on the board on December 22nd and Mr. N. Carlton was appointed on February 23rd.

Lancashire United Tramways, Ltd. (87,044).—A debenture, dated February 15th, 1906, to secure £37,702 0s. 9d., has been registered. Property charged: The company's undertaking and property, present and future, including uncalled capital. Holders: Parr's Bank, Ltd., 4, Bartholomew Lane, E.C.

Madras Electric Supply Corporation, Ltd. (87,409).—A trust deed, dated February 22nd, 1906, to secure £250,000 "Construction" debenture stock, has been registered. Property charged: The company's undertaking and assets, including uncalled capital. The company further undertakes to execute a mortgage on the whole of its undertaking in connection with the Madras Electric Licence, 1905, and all property connected therewith. Trustees: C. C. Cave, 13, Cranley Gardens, S.W.; and C. F. Tufnell, Watendone Manor, Kenley, Surrey.

W. R. Sykes Interlocking Signal Co., Ltd. (62,522).—A trust deed, dated February 27th, 1906, to secure £15,000 debenture stock, has been registered. Property charged: Leasehold premises at Clapham and the company's general assets, except uncalled capital. Trustees: J. E. Nichols, Sussex House, Ravensbourne Park, Catford; and A. H. Johnson, Winfrion, The Avenue, Bickley.

British Prometheus Co., Ltd., Kingston (74,889).—A memorandum of satisfaction in full of debentures dated November 7th, 1903, securing £2,250, has been filed.

British Prometheus Co., Ltd., Kingston.—A memorandum of satisfaction in full of a debenture, dated October 17th, 1905, to secure £500, has been registered.

CITY NOTES.

Perth Electric Tramways, Ltd.

The annual meeting was held on Wednesday at the offices of the London Chamber of Commerce, Salters' Hall Court, Cannon Street, Mr. Allen H. P. Stoneham presiding.

In proposing the adoption of the report (see Electrical Review, March 16th), the Chairman, after referring with regret to the death of Mr. Edward Heasman, the first chairman of the company, said the shareholders were to be congratulated on the progress which the company had made since its inception six years ago. The original concession which was granted them was for about 17 miles of track, and in the year 1902 on that 17 miles the traffic receipts amounted to £54,853, and the net profits to £20,592, or a rate of £1,211 per mile. Since 1902, the system had been extended, and they now owned 22 miles of line, and whilst the traffic receipts had increased to £73,255, the net profits had increased to £32,041—in other words, by the addition of 5½ miles of track, they had increased the traffic receipts by nearly £19,000 and the net profits by nearly £12,000. The average profit for the whole system was now £1,544 per mile. Of course, those extensions had required a considerable expenditure of capital, not only for the track, but also in the provision of increased engine power, an extra dynamo, and extra cars. A considerable proportion of that expenditure had been met by their having put aside a portion of their profits to that end—a course which had been amply justified by the results achieved. Turning to the present year's accounts, they had a sum of £32,041 to deal with. Of that amount £16,829 was absorbed by debenture interest, trustee fees, and sinking fund, leaving £15,212. That again had been reduced by £6,000—the preference dividend, but increased by £3,462, which was the amount brought forward from last year; leaving a net sum of £12,675 to be dealt with. They proposed to add £5,000 to the reserve account; to place £2,500 as the first instalment of a cash reserve account, which was a prudent course in the best interests of the shareholders; to pay a 2½ per cent. dividend on the ordinary shares, and to carry forward the balance of £2,675. As far as the current year was concerned, he was glad to say that their traffic receipts again showed an increase over those of the corresponding period of 1905, so he thought they might safely look forward to a dividend on the ordinary shares again next year. He did not at present hold out any hope that they would be able to pay more than 2½ per cent. for another two or three years, for their concession was only for 35 years, and as prudent business men they must build up such a cash reserve fund that at the end of that period they would have sufficient cash assets to represent the whole of their share capital. He had been asked a question as to possible competition by motor-omnibuses. No one who knew anything about the working of electric tramways feared such competition. They had had very severe competition in that respect; but, although they affected their traffic for a little time, they proved an expensive luxury to the owner, and the last of those 'buses ceased running last December. That, he thought, would always be the case where such vehicles attempted to run in competition with electric tramways. As feeders to the tramways they were undoubtedly useful, but they had yet to learn that they would be a commercial success, even in London. As to the future of Perth, he (the chairman) believed it would increase in importance

and that the population would continue to grow. The company experienced no difficulty in regard to labour; they paid 1s. an hour at Perth and 1s. 3d. per hour at Kalgoorlie, in return for which they got good and efficient service.

Mr. Charles Wren seconded the motion.

Replying to a shareholder, the Chairman said he would not like to say that they would be able to increase the dividend next year, although possibly they might. They had to construct the North Perth extension this year at a cost of about £5,000 or £6,000, and that would have to come out of the profits. That was a better policy, however, than piling up a huge capital expenditure.

The report was then adopted.

Yorkshire (West Riding) Electric Tramways, Ltd.

The report states that the profit on working from the opening of the lines on August 15th, 1904, to December 31st, 1905, amounted to £19,461, of which £8,110 was earned prior to the formation of this company on April 6th, 1905, and is consequently only available for capital purposes. After payment of revenue charges and debenture interest, a balance of £1,306 remains, which it is proposed to carry forward. The powers under which the lines have been constructed were obtained by the Wakefield and District Light Railway Co., whose share capital is owned by this company, and the traffic accounts are nominally those of the Wakefield Co., which, however, hands over all the profits to this company. A contract has recently been entered into for the completion of the section between Normanton, Castleford and Pontefract, a considerable portion of which has already been constructed, but not opened for traffic. The traffics show from week to week a steady and satisfactory increase.

Mr. H. S. Leon presided at the first ordinary general meeting of the above company at the offices, 14, Victoria Street, S.W., on Wednesday.

In moving the adoption of the report, the Chairman said of course the shareholders knew the system was not yet fully developed, and a part of it was not even ready for traffic, so that they had to look to the future for development. For the first 10 weeks in this year their receipts were £2,000 up, or an average of £205 per week. If the traffic were maintained, it would mean that during the whole of this year, they would make an increase of £10,000. The unfinished portion of the system was from Normanton to Pontefract and Castleford, and upon that £40,000 had been spent. That amount, added to the £35,000 capital in hand, meant £75,000 unproductive capital. The cost of the completion would not be less than £65,000, and therefore another £30,000 would have to be borrowed, but that amount would, he thought, be arranged for without increasing the debentures. The income was equal to about 7·184d. per car-mile, and the total working expenses were equal to 3·768d. per car-mile, which, he believed, was a result not equalled by any other system of tramways in the world. The arrangement for running powers with the Leeds Corporation was completed in June last, and although the traffic had not been so large as anticipated, yet everything had worked smoothly, and, in fact, their dealings with all the local authorities had been very friendly.

Mr. G. E. Leon seconded the motion, and the report was adopted.

Bournemouth and Poole Electricity Supply Co.

The meeting was held on Wednesday at the offices, Moorgate Court, Mr. J. Atkinson Hosker, the vice-chairman, presiding.

In proposing the adoption of the report (see Electrical Review, March 16th), the Chairman said he was sorry to say that Mr. Sanderson, the chairman of the company, was detained abroad owing to illness. As to the company, it was an exceedingly prosperous one, and he believed its prosperity would continue in the future. Last year they exhibited a considerable increase both in the gross and the net revenue. There had been a satisfactory increase in the number of units sold and the lamps applied for; and what was a gratifying feature was that they were able to report a very considerable decrease in their works' cost. The calls in respect of the balance of the ordinary share capital issued last year had been paid up during the year, and the total share capital now stood at £300,000. The balance of the £20,000 4½ per cent. debenture stock issued in 1904 (£10,000) had been received during the year, bringing the total up to £150,000, which completed the company's borrowing powers for the present. The balance at the credit of reserves from premiums received £3,935, had been transferred to the credit of reserve for depreciation, which fund now stood at £16,387. That was an increase over last year of £2,018. That had been arrived at by transferring the £3,935 to which he had just referred, and £3,000 from the revenue account, and deducting £4,916 that had been written off the machinery account. Last year they had expended £45,193 on capital, of which £17,880 was in respect of mains, £6,472 in respect of buildings, and £13,750 for machinery. That additional capital expenditure was associated with an increase in the revenue of £5,971, or about 13 per cent. The sum they had invested in the Richmond company had been increased by a further £12,500. The gross receipts had increased from £40,414 to £46,385, and of that increase, £4,054 had been brought in from sales of current. Coal and fuel, oil, waste and water showed a decrease. That was a most satisfactory feature, considering the increased output over the previous year, and it spoke well for the engineer and staff. They had sold something like £400 worth more current, and coal had cost them about £300 less. Another point bearing on the economical working was that the units unaccounted for had decreased from 15 per cent. to 14 per cent., and the cost of generation and distribution had decreased by 10 per cent. The item of repairs was again heavy, but that they must expect. Rates and taxes also showed an increase of £265. Taking the whole of the increases, it would be found that they amounted to £1,138, bringing up the total expenses to £17,762, as against £16,624. They proposed to add £6,935 to reserve for depreciation as against £3,500 last year, but it must be remembered that that amount was taken from the premium reserve account, whereas this year it was taken from revenue. The £4,916 which had been written off the machinery account had been for putting in new and up-to-date plant, and virtually scrapping all that was old and obsolete. They had spent something like £17,880 in laying mains in new districts last year out of revenue. When they were working in a progressive town like Bournemouth it was important that the company providing electricity should place their mains through newly-developed estates so as to be able to show builders that as soon as their houses were occupied they were ready to supply them with electricity. That policy had paid them in the past and he believed it would continue to pay them in the future. Their total connections during 1905 for their new extensions were 362 consumers, with an equivalent of 9,305 8-c.p. lamps, and the total motor and heating current was 103¼ h.p. Since the commencement of this year they had 128 more consumers, with an equivalent of 3,982 8-c.p. lamps. The total number of units sold by the company for lighting, power and traction purposes during the year was 2,005,025, being an increase of 301,696 units in the 12 months.

The report was adopted.

Official Announcements re Companies.

It is notified in the *London Gazette* that the names of the following companies have been struck off the register, and they are accordingly dissolved:—

Anglo-Continental Electro-Medical Vapour Baths Co., Ltd.
Atlas Electric Appliances Co., Ltd.
British Electrical Manufacturing Co., Ltd.
British Spiral Telephone Wire Syndicate, Ltd.
City and Suburban Electric Carriage Co., Ltd.
Electrical Insulator Manufacturing Co., Ltd.
Electric Carbon Storage and Apparatus Manufacturing Co. of Scotland, Ltd.
Electric Manufacturing Co., Ltd.
"Electric" Paint Remover Co., Ltd.
Electric Portable Battery and Gas Igniting Co., Ltd.
Elwell-Parker, Ltd.
French Electrical Power Storage Co., Ltd.
Morecambe Electric Launch and Power Syndicate, Ltd.
Mutual Telephone Co., Ltd. (Registered February 4th, 1890.)
Petroleum Engine Co., Ltd. (Registered July 1st, 1884.)
Railway and Domestic Electric Lighting Co., Ltd.
Rocking Fire Bar Syndicate, Ltd.
St. George Telephone Co., Ltd.
South Kensington Mutual Electric Lighting and Supply Co., Ltd.

The following are to be struck off within three months, unless cause is shown to the contrary:—

Electric Locomotive and Power Co., Ltd.
Electrified Rooms Co., Ltd.
Electro Metal Extracting, Refining and Plating Co., Ltd.
Lartigue Railway Co., Ltd.
Lartigue Railway Construction Co., Ltd. (Registered November 4th, 1886.)
London Battery Co., Ltd.
Telephone Association, Ltd.

Cork Electric Tramways and Lighting Co.

The meeting of this company was held on Thursday of last week at 83, Cannon Street, E.C., Mr. A. R. Monks presiding.—The Chairman, in proposing the adoption of the report (see Electrical Review, March 16th, p. 441), said he was sure it would be satisfactory to the shareholders to know that the company had more than maintained its position last year, and, as regarded the current year, he had every reason to think that their business would increase—especially the power business. They were now in negotiation for two important contracts, which would add considerably to their income, with very little additional capital outlay. As they would see by the engineer's report, the permanent way, plant, &c., had been maintained in good working order and repair.—Mr. W. Anderson, J.P., seconded the motion, and the report was adopted.

Eastern Telegraph Co.—The directors have declared an interim dividend of 1½ per cent. on the ordinary stock for the quarter ended December 31st.

Great Northern Telegraph Co. of Copenhagen.—The directors recommend the same distribution as last year, namely, 24 per cent. dividend (including 5 per cent. already paid).

British Insulated and Helsby Cables, Ltd.—The annual meeting was held at Liverpool on 21st inst. Mr. E. K. Muspratt, the chairman, said the company was now in a very strong financial position, and the balance-sheet would compare favourably with those of other companies in the same business.

Sao Paulo Tramway Light and Power Co.—A quarterly dividend of 2 per cent. has been declared on the ordinary shares.

Bruce Peebles & Co., Ltd.

The directors' report for 1905 states that the net trading profit, after providing for depreciation and all necessary charges in connection with the management of the business, amounts to £43,143. Deducting directors' and managing directors' remuneration and auditors' fees, interest on debentures and income-tax, there is a balance of £36,431, to which falls to be added £3,854 brought forward at December 31st, 1904, making the total amount to be dealt with £40,285. The dividend on the preference shares, less income-tax, for the half-year to June 30th, 1905, was paid on September 30th, 1905, requiring £3,037. The directors recommend:—

A dividend on the original issue of preference shares for the last half-year at the rate of 7 per cent. per annum (making 6½ per cent. for the year, which, less income-tax, will absorb	£3,325
A dividend of 6½ per cent. per annum on the new issue of preference shares, which, less income-tax, will absorb	1,559
The placing to preference shareholders' special reserve fund, as provided by the articles of association, being not less than 10 per cent. of the net profits	3,643
Dividend on the ordinary shares at the rate of 6½ per cent. per annum, less income-tax, requiring	6,358
Writing off the whole of the preliminary expenses and one-half of the expenses in connection with the new issue of shares and debentures in 1905	8,091
Transferring to general reserve account	7,000
Carrying forward	7,271
	£40,285

The directors consider the position of the company to be satisfactory. The turnover for the year has again been greatly increased, and the value of current contracts and orders in hand exceeds that of any previous year. Several new and valuable channels of business have been opened up, and a great amount of development work in connection with new types of machines has been carried out during the year, necessitating considerable expenditure, all of which has been charged to revenue. The preference shareholders' special reserve fund is invested in trustee securities, and including the sum to be transferred thereto, will amount to £7,722. The general reserve account, including the sum to be transferred, will amount to £15,000. The shares in power and traction companies acquired by the company in part payment of certain contracts have been valued by the directors at considerably under par, and they believe the valuations to be reasonable. Since December 31st £10,000 of these have been sold. The issue of further capital has been carried out to the extent of the issue of 10,000 6 per cent. preference shares of £5 each and 1,049 ordinary shares of £5 each. The directors have also, as authorised, exercised the borrowing powers to the extent of £75,000, by continuing for a period of three years the £50,000 temporary debentures issued in 1904, and issuing a further £25,000 debentures for the like period.

County of Durham Electrical Power Distribution Co.

The annual meeting was held at Newcastle-on-Tyne on the 15th inst., Dr. J. T. Merz presiding.

The Chairman, in moving the adopting of the report (see Electrical Review, March 9th), stated that their business had increased by 1,753,000 units. The revenue had been £29,847 against £26,400, and the total profits had been £15,723. The capital of the company now stood at £380,000 paid up. The preference had been fully paid up, but on the ordinary shares only £2 had been called in. Almost immediately there would be a call in respect of the latter shares to meet various contingencies.

Sir Lindsay Wood seconded the report, which was carried.

Hove Electric Lighting Co.

Col. A. J. Filgate, R.E. (chairman), presided at Salisbury House on Thursday last week over the fourteenth annual general meeting of the above company.

In moving the adoption of the report, the Chairman said that the capital expenditure during the year had amounted to £3,360. Of this, £2,550 had been expended on strengthening and extending the mains and £416 on meters. The total length of the network was now 20 miles 442 yards, and of their feeders 8 miles 1,275 yards, the total length of mains being 28 miles 1,717 yards. The capital expenditure up to the end of the year had amounted to £156,092. Of this sum £71,936 had been provided out of the share capital, £44,600 from debentures, and the balance had been found out of the reserve fund. They did not anticipate any large expenditure during the current year, but they had found it desirable to make a further call of £1 per share on the last issue of shares at an early date. The net profits had amounted to £12,490, as compared with £11,807 in 1904, or an increase of £683. The improvement, however, was better than this. At the end of 1904 they had only shown in the revenue account a sum of £600 as outlay on repairs and maintenance which they had to expend or set aside in accordance with their contract with the Hove Corporation, and had provided the expenses from the maintenance and repairs account. This course was not satisfactory, and they had decided to charge the whole of each year's expenditure under this head direct from revenue. The number of houses on the system at the end of the year was 1,374, an increase of 137. The lamps and motors connected reached the equivalent of 92,194 8-c.p. lamps, as against 82,867 at the end of 1904, an increase of 9,327. This was the largest increase they had had in any year for some time. The units sold to customers amounted to 901,384, against 820,781 in 1904, an increase of 88,603, or 9·8 per cent. The gross revenue for the year amounted to £21,040, as against £19,996 in 1904. The total revenue expenditure was £8,550, compared with £8,188, but allowing for the full outlay on maintenance and repairs the actual expenditure of the two years had been £8,550 in 1905 and £8,575 in 1904. Thus, while their revenue had increased by £1,044, their expenditure had diminished by £25. This must be looked upon as a most satisfactory result, for which they must thank Mr. C. B. Smith, their engineer at Hove, and his staff, and also their secretary, Mr. F. R. Reeves, who have all devoted every care and attention to the business. With the balance brought forward they had £12,815 to deal with in the profit and loss account. From this had to be deducted £1,746 for interest on debentures, loans, &c., £2,712 for interim dividend, and £506 for income-tax, leaving a balance of £7,851. The board recommended that £3,250 should be placed to the credit of the reserve account, increasing the amount of this fund to £38,576; to add £250 to the maintenance and repairs reserve fund account, and so increase that account to £925; to pay a final dividend for the half-year at the rate of 10 per cent., making 9 per cent. for the year; and to carry forward £965. Their business continued to expand, and the option they gave to their customers on the 220-volt supply of a flat rate of 5½d. per unit for lighting had proved popular. They had recently placed another proposal before the Hove Corporation to make a further reduction if that body would support them in obtaining an order for a compulsory change of all customers now on the 110-volt system to the higher voltage. Both the customers and the company would benefit by this change, and as there were now only 58 houses on the 110-volt pressure, they hoped a satisfactory arrangement would be arrived at. When it was considered that the results he had placed before them had been arrived at during a period when a large number of houses that had previously used their current were empty, and consequently disconnected from the system, he thought they had every reason to be satisfied with the year's working.

Mr. C. F. Tufnell seconded the motion, and the report was adopted without discussion.

Mersey Railway Co.

The report for the half-year ended December 31st states that the train mileage run during the half-year was 417,683 miles, as compared with 415,625 during the corresponding six months of 1904. The number of passengers conveyed during the half-year has been 4,937,840, including omnibus passengers, as against 4,657,876 for the corresponding period of 1904, exclusive of season ticket holders. Total receipts from all sources have been £44,060, as compared with £41,789 for the corresponding period of 1904. The working expenses, exclusive of the charges for pumping, ventilation and lifts, have been £30,471, equal to 69·16 per cent., as against £29,029, equal to 69·17 for the corresponding six months. These charges for pumping, ventilation and hydraulic lifts for the past half-year amounted to £3,837, equal to 8·71 per cent., as compared with £3,854, or at the rate of 9·22 per cent. for the corresponding period of 1904. A service of motor-omnibuses was inaugurated on December 11th, 1905, but in consequence of an injunction granted by Mr. Justice Warrington at the instance of the Birkenhead Corporation, this service has been suspended. The board record the deaths of Mr. Francis More and Mr. Samuel Gurney Sheppard, which have occurred since the last half-yearly meeting. They have filled up the vacancies by electing Mr. Robert Cooper and Mr. Henry Allan Wakeman-Newport.

Direct Spanish Telegraph Co.

The Marquess of Tweeddale, K.T., presided at the meeting of this company at Electra House on Tuesday. In moving the adoption of the report (see Electrical Review, March 16th), he said that the traffic receipts showed an increase of £118, against a decrease of £233 last year. On the Bilbao section there was a decrease of £650, owing to the tariff being reduced since June, 1904. Happily, the traffic of the Barcelona-Marseilles section showed an increase of £750, due to the absence of those numerous and costly interruptions which had occurred so frequently during the last few years. He hoped that they had seen the last of those interruptions now that the cable had been put into a thoroughly efficient condition. The cost of doing this had been large, but during the last four years the average cost of repairs was £5,000 per annum, and they would recognise that the expense was fully justified. After briefly referring to the items showing increases and decreases in the expenses, the Chairman said that they recommended the usual dividend of 10 per cent. on the preference and 4 per cent. on the ordinary shares. The reserve fund now stands at £49,279—an increase of £2,000. The improvement in trade to which he referred at the last meeting happily continued, and was reflecting considerable increases in the income so far as the year had gone. They might, therefore, look forward to a prosperous year.

Sir J. Denison Pender seconded the adoption of the report.

Col. Pearson referred to £20,000 of second mortgage debentures raised during the year, evidently for the expenditure on the Marseilles-Barcelona cable. He thought it would have been better to realise some of the investments. The charge against revenue for interest on these debentures was £900 per annum. They had had to draw from the reserve in order to pay the balance dividend. It might be good policy to pass the interim dividend, and wait and see if the 4 per cent. was justified at the end of the year.

The Chairman said that the debentures were raised for placing the cable in a perfect condition. They had power to pay them off at the rate of £2,000 a year. Whether it was desirable to realise

investments depended upon the market value, and so on. It was quite true that amounts had been taken to pay the dividend, but the reserve was larger than last year, and therefore the position of the company was stronger. He did not think shareholders would approve of the suggestion that the dividend should be held over.

The report was adopted, and the retiring director and the auditors were re-elected. Thanks to the board and staff closed the meeting.

Newcastle-on-Tyne Electric Supply Co.

The annual meeting was held on 15th inst. at Newcastle, Dr. J. T. Merz presiding.

The Chairman said, in moving the adoption of the report (see Electrical Review, March 9th, 1906), that the sale of units showed an increase of 13,246,700 for the year. The increase was very considerable, and consisted of units that they had supplied in very large quantities to the North-Eastern Railway Co. and the Durham Co. at a fixed price, plus a charge for horse-power. This explained why, although there had been a very large increase in the units supplied, there had not been a corresponding increase in the profits. The lighting units for the year were 143,125 more than the year before, and they would be still more if they took in the increased number of units which were consumed by the customers with whom they had agreements for supplying the whole of their power and lighting. The lighting units which they supplied to the North-Eastern Railway Co., which were very considerable, were not included in the electric lighting bill, because they had agreements with the company to supply them with energy for all purposes. The cost of making and delivering units had been reduced by 0·10d. — from 0·66d. to 0·56d. The price had been reduced from 1·295d. to 1·035d. The revenue had been increased from £108,900 in 1904 to £140,307 last year, an increase of £31,350. The profit had been £74,653, against £61,440. The capital account stood at £750,000 on the two denominations of shares, against £714,000 in the year before. The whole of the capital had now been paid up. The debentures now stood at the same figure, £250,000; loans at £61,000, £7,000 less than last year. The total increase in capital was £28,281. The total expenditure was £1,192,442 up to December 31st, 1905. They had now 3,800 customers against 3,316. Speaking as to the depreciation, he said they had added to that account £25,000, and the total depreciation now amounted to £156,000, and besides that they had in the reserve account £12,184. It was proposed to increase the capital of the company, and this was necessary because the company had entered into agreements for the sale of current to two large companies, and these two firms would consume as many units as the present output of the company—30,000,000. One of the companies was a chemical company, which would take power all the year round, day and night. This would necessitate an increase of plant, and there was a certain amount of debt to liquidate.

Mr. T. G. Gibson seconded the report, which was adopted.

Dividends of 5 per cent. and 8 per cent. respectively on the preference shares and the ordinary shares (of which 2½ and 5½ per cent. had been paid as interim dividend) were agreed to.

An extraordinary meeting was then held, when sanction was given to the creation of capital to the amount of £250,000, half preference and half ordinary shares of £5 each.

South London Electric Supply Corporation.

Mr. J. Atherton, chairman, presided on the 14th inst. at the Cannon Street Hotel over the meeting of this company.

In moving the adoption of the report (see Electrical Review, March 9th) the Chairman said it was with pleasure that he was able to announce that steady progress in their business continued to be made. The lamps added to the circuits were equivalent to 13,412 of 8 c.p. This number had been added to considerably since the commencement of the year, and there still remained on the books awaiting connection the equivalent of nearly 5,000 lamps. Negotiations were in progress with several manufacturers for the supply of power. They were always endeavouring to increase their day load, and for the past three years they had let out motors on hire, and were now arranging a hire-purchase scheme. In July last the price for current used for lighting purposes was reduced from 5½d. per unit to 4½d. per unit. This reduction was necessitated by the severe competition with the gas company, and it had been the means of bringing them a considerable increase in their business, and, further, had prevented the loss of consumers who would otherwise have reverted to the older illuminant. Their company was the only electric supply authority in London that had to compete with gas at 2s. per 1,000 cb. ft. in every part of its area. There was one fresh item in the accounts, which was the costs incurred in opposing Bills in Parliament last year, viz., £1,959. These costs were incurred in successfully opposing new schemes in connection with undertakings proposed to give both a bulk and, in some cases, direct supply to premises within their area of supply, and, in fact, throughout the metropolis. Such schemes, had they been passed in the form in which they were introduced, would have most injuriously affected the interests of the shareholders. Some of those schemes had again been introduced in the current Parliamentary session, and the board had again lodged petitions against those that were likely to affect their interests; but he was glad to say, from information since received, that the costs would be nothing like those of last year, as clauses had been agreed to which gave the fullest satisfaction to the directors. As in the case of most of the other electric lighting companies in the metropolis, they should from April next have to bear an increased burden of rates. The rateable value during the last quinquennial period——viz., £3,000—would be increased to £4,000, with an additional sum proportionate to the income derived from their contracts for steam supply to the London County Council. Whilst mentioning the L.C.C., the three years' contract entered into in 1901 for steam supply would expire on May 15th; but he was pleased to say that they had just concluded negotiations for a supplemental contract from that date, which they hoped would benefit the revenue account for some time to come. The capital expenditure during 1905 had been on a moderate scale, the principal item being for an additional 900-kw. steam alternator which had been installed in the existing generating station, and was now running on the load satisfactorily. The only other amount of any importance was the cost of additional mains, which, of course, only reflected the increase in the company's operations, and the connection of additional consumers. There was an item in the capital account under the heading "Machinery and Plant Fixed," for accumulators which during the past year were put out of use and sold, and the sum of £1,237 10s. had been provided out of depreciation fund account to meet this demolition. They did not anticipate that it would be necessary to raise any further capital during the year, but the provisional debenture bonds issued by the company in 1904 would become due for repayment on April 1st next year, and they would give careful consideration to the question of an issue of debentures for this purpose at a more moderate rate of interest. The balance of the cost of issuing these short-term debenture bonds had been provided out of this year's revenue. The cost per unit sold had again been reduced, and now stood at 1·04d., and was the second best of any of the metropolitan companies. The cost of coal per unit sold was lower than in the previous year, and would have been further reduced had it been possible to conclude the agreement with the railway company for the provision of a siding into their works. It was hoped that a settlement would be arrived at very shortly. The two actions brought by the Lambeth Borough Council against them for repayment to the Council of the expense incurred by the Vestry and the Council for the removal of the dust bin refuse from 1900 to 1904 on the contract which the Council themselves prevented them from carrying out were heard in November, and he was glad to say were dismissed with costs against the Council. The Council had since served a notice of their intention to appeal against these decisions, and so apparently to continue their unsuccessful litigation against the company which they began more than five years ago. The profit available for distribution under all the circumstances must be considered satisfactory.

Mr. F. J. Leslie seconded the motion, and characterised the action of the Lambeth Borough Council as nothing less than persecution. The Council got the magistrate to make an order to prevent them from carrying out an agreement and now sought to obtain damages because the agreement was not carried out. If the Borough Council were to succeed they would get about £4,000 a year.

After some further discussion, the report was adopted.

City of London Electric Lighting Co.

The meeting of this company was held on the 14th inst. at Salisbury House, E.C., Mr. J. B. Braithwaite presiding in the absence of Mr. G. Herring (chairman).

The Chairman, in proposing the adoption of the report (see Electrical Review, March 9th), said that the capital expenditure had been small—only £32,000—and the whole of that had been provided without making any fresh issue of capital. In spite of competition, which had last year been the most severe they had ever had to contend with during the company's existence, their revenue showed an increase, and also their net profit. The gross revenue showed an increase of about £7,000, the total being £261,994 against £255,087, and that was in spite of the fact that the price they had received for their current had fallen by nearly ½d. per unit. The price for the past year had been a fraction over 2⅞d. per unit for the whole of their output. In the face of the fact that the price had fallen ½d., they would readily understand how much credit attached to their technical and engineering staff, that their net profit was somewhat larger than in the previous year. The economy that had been effected in their engineering department in the cost of generation and distribution represented 15 per cent., which he thought was a very great achievement, following as it did upon successive reductions in previous years. In spite of the severe competition to which they continued to be subjected, as he had said, they had been able to maintain their position, and they were enabled to pay the same rate of dividend—6 per cent., after putting away the same amount to reserve as the previous year, and, in addition, providing £2,500 out of revenue towards the liquidation of the costs of the opposition to the various power Bills, and also the cost of the attempts which they made to obtain additional Parliamentary powers on their own behalf. The increase in the equivalent of 8-c.p. lamps last year was just on 91,000, against an increase of 87,276 in the previous year. Of that increase, close on 57,000 lamps represented power and heating supply. The heating supply was of some little interest to them, because it added to their summer load, which was a most desirable thing. At the present time they had 2,000 radiators connected to their mains, and he hoped that number would be increased to 10,000 at no very distant date. The

progress made during the current year as far as it had gone was very satisfactory. They had an increase of 15,415 8-c.p. lamps, as against an increase of 9,436 at the same period of last year, so that from every point of view their position was an extremely satisfactory one, as far as they could judge. This year they had been able to ascertain the exact figure for the various demolitions and replacements which had taken place during past years, and they had written that sum off their depreciation reserve. They still had a substantial depreciation fund, which at the present time they were adding to at the rate of £45,000 a year. The company was attacked in Parliament last session by various power schemes, the great feature of which was that they desired to compete with them for their best power customers. He was glad to say that they were successful in opposing those Bills. They were not successful with their own Bill by which they sought power to supply railways and other large consumers in bulk, but they would re-introduce that Bill this session. Other power Bills were also being brought forward this session, and they were taking all necessary steps to safeguard the company's interests. Personally, he thought the scare which had seized hold of electric lighting company shareholders in view of the power schemes that had been proposed, was somewhat excessive, because the mere power to supply electricity in bulk, as long as it was not coupled with power to compete with supplying to the ordinary consumer, would not be any detriment to them. It might possibly be an advantage to them to take their power from a bulk company if they could supply it more cheaply than they could manufacture it themselves. As a further illustration of the economy in working, he might mention that they had sold 3,333,000 more units last year, and it had only cost them £1,071 extra in expenses to produce them.

Mr. Frederick W. Reynolds seconded the motion, and the report was adopted.

Salisbury Electric Light and Supply Co.

The directors report that the progress made during the year has been satisfactory. The number of consumers has been increased from 820 with 26,674 lamps connected, to 938 with 30,217 lamps connected, thus showing a steady increase.

The generating plant has been sufficient to meet the output, and the whole of the plant is at present in thorough working order and capable of dealing with a considerably increased demand.

5,000 new shares and 22 debentures of £100 each have been issued during the year, bringing the share capital of the company up to £35,000 and the debenture issue to £29,700.

The profit on the year's working, including £214 brought forward from last account, amounts to £5,170, and after paying £1,711 interest on debentures and temporary loans, an interim dividend at the rate of 4 per cent. for the half-year, amounting to £600, and £126 on exhibition account, there remains a balance of £2,733 to be dealt with. The directors recommend that a further dividend at the rate of 7 per cent. for the half-year be paid, making a total dividend of 5½ per cent. for the year, and that £1,500 be placed to reserve, leaving £183 to be carried forward.

Statement of Electricity Generated, Sold, &c., 1905.

Units generated	526,901
Sold—public lamps	10,200
Private consumers	417,660
Total	427,860
Used on works	56,853
Total accounted for	484,713
Not accounted for	42,188
Number of public lamps	33
Total maximum demanded	296 kw.

A. B. Randall,
Resident Engineer and Manager.

Metropolitan Electric Supply Co.

Mr. W. Harrison Cripps presided at the annual meeting, held at Winchester House, on Tuesday, 13th inst. In moving the adoption of the report (see Electrical Review, March 9th) he said that at the end of 1904 the capital account stood at £1,539,582, but it now stands at £1,696,007, an increase of £156,425. One of the chief items in that large increase was the removal of Sardinia Street station. That station had been taken by the L.C.C., and that body awarded a considerable sum for it. It had not been necessary for them to replace it as a station, but they had had to alter their mains and methods of supply, and to add sub-stations in the mid-London district to compensate for the loss of Sardinia Street station. At the same time it had involved a certain amount of expenditure at Willesden for new machinery which had been erected in the place of the old. Then during the year there had been the expenditure upon the alteration of the system in Paddington, and they were altering the system there from high tension to low tension distribution. That work had already been completed in mid and south Paddington, and only remained to be completed in the north. Their engineer said that that change when complete would not only produce a considerable saving in working costs, but it would be practically all they would want to spend upon capital so far as distributing plant was concerned, except for new customers, for some years to come. The shareholders had not been called upon to subscribe any new capital directly providing for that large expenditure of the year; it had been entirely met out of the money received for Sardinia Street, and from the Marylebone award money. A sum of £10,000 was kept back from the award, for certain difficulties had arisen about the title, but those had now been satisfactorily cleared up, and that money had been returned to the company, and out of it about £7,000 had been expended in further alterations in leaving Manchester Square station. That left some £2,649, which had been put into the general investments. Turning to the revenue account, the sale of current, &c., during the year produced £269,000, for, roughly speaking, 14 million units. Last year the total revenue was £306,540, so that there had been a decrease in 1905 of £37,533. The works costs had been £108,724, as against £129,703 in 1904. Therefore, although they had lost in revenue £37,000 they had saved in works costs £21,000; in other words, their revenue had decreased 12 per cent., but the works cost had decreased by no less than 16 per cent. They would wonder why they had lost that £37,000 if they were progressing so well. It was entirely due to the loss of Marylebone. Last summer Marylebone took over a very large part of the supply which up to that time this company had been giving them as agents. At the present moment they had practically taken over all the supply, so that except for a very small bit of the area the company were entirely dependent upon what they might call their old districts, which remained to them. Losing this business in Marylebone, for which they been paid, had set free a good deal of plant at Willesden, and it had been a very anxious consideration with the directors how to find new employment for it. To the reserve fund this year they had added £20,000, which now brought it up to £236,000. They considered £20,000 a year that they had been putting by recently a very ample addition to that fund, for of present plant—after they had got rid of Sardinia Street and Marylebone—three-fourths was less than eight years old. They had got a splendid site on the new Kingsway, which stood in the books only at the value of the old site in Sardinia Street, which was up a back street that nobody knew anything about. They had got a magnificent area, with a magnificent frontage, which they were waiting for a favourable opportunity either to let or sell. After showing how it was proposed to deal with the revenue (paying 10 per cent. on the ordinary shares for the year, and carrying forward £2,219) the chairman said that last year they applied for a new district altogether, outside their London area, in which to supply in bulk. They were one of the very few companies that came out well in last year's Parliamentary contest, and they had given to them the right to give bulk supply in that new area—in west and south Middlesex. They had added 125 sq. miles of country—a district which they believed would very rapidly develop, and would within measurable distance become a very valuable outlet for supply. In their already existing area they had had a most successful year, having added more than 80,000 lamps (equivalent) there. That was the largest increase in those districts at any time since the company was started, so that they were still making steady progress in that way. It was pleasing to see how quickly they were getting on with the supply of power. They were beginning to do a very large business, and with their magnificent station at Willesden, they held before Parliament that they could supply bulk and power just as cheaply as any of the proposed new companies. So far as they could see, none of the new companies now applying to Parliament very much affected this company. They would settle down to develop their new district, and he did not believe that even the present Government would trouble them there—they did not see their way to get enough out of it at present. In regard to what they were going to pay as dividend for the current year, he said that they could not hope this year to sell such a large amount, because not only had they lost half Marylebone, but this year they would have nothing whatever in Marylebone, and they would lose the whole of that revenue. Although they would, to a certain extent, make that up by the additional business, none of them could expect in a single year to make up practically the loss of one-third of their whole income. "Sufficient for the day was the evil thereof," and next year they would be able to tell them how much business they had got in substitution for the old. They knew perfectly well when they lost Marylebone they would have Willesden station with a large amount of unemployed machinery, and they made a great point of that fact before the arbitrator, who in his award gave a certain sum in compensation for the loss of the business in Marylebone during the years after they had lost it before they were able to pick up the supply by the natural increase of business. They might have said that they would have divided that money—although they did not know what that particular sum was—as a bonus. They did not do that, for they considered that on the whole it was better in a company like this, instead of paying 10 or 12 per cent. one year, and 2 or 3 per cent. the next, to equalise the dividend, so that they held in reserve, all invested in first-class securities, a very considerable sum which they had not touched yet. A portion of that sum ought to be, and they intended it to be, legitimately used to equalise the dividend during the year or two if it showed, as they were afraid it might, some diminution until they picked up the business again. They had that money in hand for them if emergency should arise. The chairman briefly referred to the death of Mr. Verity, a director, and to the loyalty and energy of the general manager, Mr. Conacher, Mr. Cunliffe Owen, the secretary, and Mr. Highfield, the engineer.

Sir James Pender seconded the motion, and after a few remarks from Col. Perry, Mr. Fisher and Mr. John Newton, the Chairman replying, said that they refused to make agreements with any of the power companies last year. They preferred to know in their own minds what they wanted, and stick by it and carry it through. They had always been successful in that policy. Mr. Fisher had asked whether the Government could turn the company out of its new area. He believed that this Government could sell up the whole of these islands if they wished. He had no information that they would do that, but he did not know that they would not. They were applying for no Bill this session which really affected them in their London area.

The report was adopted, and the retiring directors and auditors were re-elected.

Northern Counties Electricity Supply Co.

The directors' report for 1905 says that the working operations for the year at Alnwick, Ashington, Bedlingtonshire, Blyth, Felling, Hebburn, Hartlepool, Malton, Morpeth, Shildon, Spennymoor, and Thirsk again show a substantial increase of work done compared with the previous year, as follows:—Consumers connected, 5,251, an increase of 1,468; equivalent in 8-c.p. lamps connected, 125,381, an increase of 40,347; units sold, 2,054,011, increase 1,067,138; gross receipts for current sold, £19,328, an increase of £7,047.

These results are exclusive of large consumers for power at Hebburn whose installations were in course of construction at the end of the year, but had not come into operation.

The Blyth and Cowpen districts were, up till recently, slack in their demands for current, but during the year several large power users have been arranged with in such a way that this station should soon be supplying about 1½ million units, and the directors anticipate further demands from collieries in the district.

At Hartlepool also considerable progress has been made, and negotiations are on foot with important power users. At the smaller stations, where the current is chiefly used for lighting purposes, the progress has been slower; but the directors are actively pushing this branch of the company's business.

By an agreement made with the Cleveland and Durham County Electric Power Co., the working of certain areas in north-west Durham, consisting of the Consett, Annfield Plain, Benfieldside, Stanley and Leadgate undertakings has been disposed of to that company, by which arrangement a large capital expenditure has been avoided, while the transaction leaves a surplus as shown by the accounts.

The revenue account, after an apportionment of charges and interest between construction and revenue accounts, shows a credit balance for the year of £5,210, plus £257, balance from last year. An interim dividend has been already paid at the rate of 3 per cent. per annum = £1,665, and a final dividend at the same rate is now proposed = £1,793; amount to reserve account (making it £3,000), £1,500; preliminary expenses, further amount written off, £380, the balance of £129 being carried forward. In July last the company issued at par and allotted £100,000 4½ per cent. first mortgage debenture stock, which was largely over-applied for. 14,537 ordinary shares were also issued during the year and taken up by the existing shareholders or their nominees.

Ernest F. Moy, Ltd.

The annual meeting is to be held at 4, Greenland Place, Camden Town, London, N.W., on March 27th.

The directors' report for 1905 shows that a profit of £769 15s. 9d. was earned, which, together with the amount of £92 brought forward from last year, makes £862 available for disposal. The directors recommend a 7½ per cent. dividend on the ordinary shares, 6 per cent. on the preference, to general reserve £100, and carry forward £62. The new works in Bayham Street, which were started at the beginning of last year, are now fairly well equipped with machinery, and employ a number of workmen. The extension is now proving to be of great value, and the brass foundry, which is part of the new works, has fully realised the expectations of the directors.

Stock Exchange Notices. — Applications have been made to the Committee to appoint a special settling-day in and to grant a quotation to—

British Columbia Electric Railway Co.—Further issue of £185,000 5 per cent. cum. perp. pref. stock.

And to allow the following securities to be quoted in the Official List—

Oxford Electric Co.—Further issue of 1,500 ordinary shares of £5 each fully paid.

The Committee has appointed Wednesday, April 4th, as a special settling-day in—

Electric Supply Co. of Victoria, Ltd.—£160,000 5 per cent. first mortgage debenture stock.

And ordered same to be quoted in the Official List.

Brush Electrical Engineering Co. — The directors recommend, subject to audit, the payment of the full 6 per cent. dividend on the preference shares, and a dividend at the rate of 2½ per cent. on the ordinary shares, for the year ended December 31st, 1905, placing £7,550 to general reserve, £6,893 to depreciation reserve, and carrying forward £3,114. The share transfer books of the company will be closed from March 28th, 1906, to April 4th, 1906, both inclusive. This is the first dividend on the ordinary shares since 1900.

Fairbairn, Lawson, Coombe, Barbour, Ltd. — The report for 1905 states that the profit for the year, after charging all expenses incidental to the business (including depreciation, £13,702), amounted to £134,996. The dividend on the ordinary shares is 7½ per cent. for the whole year, plus a bonus of 1 per cent. The transfer to reserve fund is £50,000, leaving to be carried forward, £17,834.

Direct United States Cable Co. — The board has resolved upon the payment of an interim dividend of 4s. per share, free of income-tax, being at the rate of 4 per cent. per annum, for the quarter ending March 31st, 1906, payable on and after April 26th.

New Capital.—The *Financial Times* states that an extraordinary general meeting of the Underground Electric Railways Co. of London has been called to consider a resolution authorising an increase in the borrowing powers by £5,000,000.

Airdrie and Coatbridge Tramways Co.—During 1905 there was expended on capital account an amount of £5,742, making the total expenditure for the tramways £61,441. The revenue during the year was £11,018 and the expenditure £9,672, which includes an amount of £2,948, interest payable to the B.E.T. Co., in respect of the amount due to them under the contract. The board recommend that £1,250 be placed to depreciation and renewal fund, and, after paying a dividend at the rate of 4 per cent. per annum on the share capital, £378 is carried forward.

Browett, Lindley & Co.—A financial daily says that the accounts for the year ended December 31st show, after meeting debenture interest, &c., a profit of £693, thus reducing the debit balance brought down to £18,404.

Marconi's Wireless Telegraph Co.—The report for the year ended September 30th, as abstracted in the *Times* (a copy has not been sent to us by the company), states that the net profit amounts to £16,750, as against £12,681 for the previous year. In view of the large expenses for development, it is thought inadvisable for the present to make any distribution. The company is making satisfactory progress, and the organisation for carrying on by means of the Marconi system the business of a telegraph company is being extended wherever profitable traffic seems likely to result and concessions can be secured. Very important improvements have been made by Mr. Marconi in the system during the past year. The new station in Canada is now finished, and has been working satisfactorily day and night for many months past. After the close of the financial year, the company made an offer of 128,063 shares to the shareholders at par. This issue was guaranteed by a group in which six of the directors were directly or indirectly interested, the consideration being an option to take a further 115,810 shares at 30s. each. Attention is drawn to the item "Shares in Associated Companies" of the par value of £1,439,285, which are taken in the balance-sheet at £62,286. It is anticipated that when the trans-Atlantic stations are opened for commercial work, such of these holdings as the company is prepared to sell will be marketable at prices which will represent substantial profit.

Gandy Belt Manufacturing Co.—Dividend for 1905, 5½ per cent. per annum. £3,000 has been written off goodwill and patents, and £1,000 added to the reserve fund. £1,011 is carried forward.

Johnson & Phillips, Ltd.—The directors' report for the year 1905 states that the profit on trading account, &c., after making provision for bad and doubtful debts, and after charging to revenue upwards of £4,000 for maintenance of buildings, plant, &c., amounts to £32,064. Depreciation on buildings, plant, &c., has absorbed £5,200, interest on debenture stock £3,078, and reserve for debenture sinking fund £1,062, while the proportion of net profit earned from January 1st to July 5th, 1905, not available for distribution is £10,169, leaving a balance of £11,769. It is proposed to pay a dividend at the rate of 7 per cent. per annum on the ordinary shares, leaving to be carried forward £6,030. The above results are considered satisfactory in view of the period of unsettled management during the earlier part of the year previous to the registration of the company. The orders in hand are of a satisfactory nature and there are signs of improved trade in the near future. A fire occurred on February 27th in the cable department, but arrangements have been made to carry out the various contracts in hand. The damage was covered by insurance.

Prospectuses.—*Anglo-Belgian Company of Egypt.*—This company has been before the public with an issue of 100,000 £5 shares at 5s. prem. Among the other objects of the company are the construction and development of railway, tramway, and electric undertakings.

The Electrical Development Co. of Ontario, Ltd. — An issue of $2,500,000 5 per cent. first mortgage sinking fund gold bonds has been offered for subscription this week at 96½ by Messrs. Chaplin, Milne, Grenfell & Co., Ltd., on account of themselves and other holders. The subscription list closes to-day.

Liverpool District Lighting Co.—At this company's meeting held on 14th inst., the Chairman, Mr. H. Gaskell, jun., said that during 1905 their business had steadily increased, and there had been a slight diminution in the cost of generating electricity. During the year the number of their 16-c.p. lamps had increased from 16,517 to 19,179, and at present the number exceeded 20,000. The current sold during the year had increased from 246,943 units to 281,057 units, or about 14 per cent., while the producing cost of electricity had decreased from 2·6d. to 2·44d. per unit. In comparing this cost with that in other places, they must not forget that this company supplied a purely residential district, where little power was required during the day. They had provided for depreciation at the normal rate, had written off the cost of the new issue of capital, and had opened a reserve and renewal fund with £250. He moved the adoption of the report, and that a dividend be declared at the rate of 5 per cent. for the half-year, making 4½ per cent. for the year. This was carried.

MARKET QUOTATIONS.

Wednesday, March 21st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal)	per ton	£33 10	..
a ,, ,,	per ton	£30	..
a Bleaching powder	per ton	£5 10	..
a Bisulphide of Carbon	per ton	£18	..
a Borax	per ton	£15	..
a Benzole (90 %)	per gal.	10½d.	..
a ,, (50 %)	per gal.	10d.	..
a Copper Sulphate	per ton	£25	10s. inc.
a Lead, Nitrate	per ton	£27	£2 inc.
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160° C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	8d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	200/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %)	per ton	£10 15	..
a ,, Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	2¼d.	..
a ,, Cyanide	per lb.	7d.	..

METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£160	..
b ,, Wire, in ton lots	per ton	£191	..
b ,, Sheet, in ton lots	per ton	£177	..
b Babbitt's metal ingots	per ton	£43 to £140	..
c Brass (rolled metal 2' to 12") basis	per lb.	9d.	..
c ,, Tube (brazed)	per lb.	10⅝d.	..
c ,, ,, (solid drawn)	per lb.	9⅝d.	..
c ,, Wire, basis	per lb.	8⅛d.	..
c Copper Tubes (brazed)	per lb.	11¼d.	..
c ,, ,, (solid drawn)	per lb.	11⅜d.	..
g Copper Bars (best selected)	per ton	£94	£1 inc.
g Copper Sheet	per ton	£94	£1 inc.
g ,, Rod	per ton	£94	£1 inc.
e ,, (Electrolytic) Bars	per ton	£92	..
e ,, ,, Sheets	per ton	£104	..
e ,, ,, Rod	per ton	£95	..
e ,, ,, H.C. Wire	per lb.	11d.	..
f Ebonite Rod	per lb.	3/3	..
,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/7	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/5½	1d. inc.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	48/4½	11d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8	per ton	£9 15	..
g Lead, English Ingot	per ton	£16 5 to £16 7 6	..
g ,, ,, Sheet	per ton	£18 10 to £18 12 6	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot	£7 7 6	..
d Mica (in original cases) small	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p ,, rolled bars & rods	per lb.	1/1½ to 1/3	..
p ,, ,, strip & sheet	per lb.	1/4	..
o Platinum	per oz.	91/6	..
e Silicium Bronze Wire	per lb.	1/- to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£168 to £168 10	80/- to 90/- inc.
n ,, Wire, Nos. 1 to 16	per lb.	1/11	..
p White Anti-friction Metals— "White Ant" brand	per ton	£46 to £70	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5⅝d.	..
j ,, 8 ply 10 lbs. Russian	per lb.	4⅛d.	..
j ,, 10 lbs. Russian, single	per lb.	4¼d.	..
j ,, 180 lbs. Jute rove	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£28 15	..

Quotations supplied by:—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, G.P. and Teleg. Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
j Walter H. Hindley & Co., Ltd.
k Morris Ashby, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Co., Ltd.

Theft of Electricity.—A South African newspaper states that at the High Court at Pretoria on February 23rd, T. H. Brown, who was recently sentenced to two months' imprisonment for the theft of electric power from the municipality, by means of an apparatus which he had fixed up to avoid the passing of the current through the meter, appealed against the sentence, on the grounds of conflicting evidence, and that electricity was not a substance to which the law on theft could apply. The Court held otherwise, saying that the accused was morally and actually guilty, The sentence of the magistrate was upheld.

STOCKS AND SHARES.

Wednesday Evening.

Foreign politics looking more settled, Stock Exchange markets are inclined to harden again. One cynical member said it would be a good thing to get the Algeciras matter arranged, because of leaving the way clearer "for the next thing." At the moment, absence of business happens to be the worst Stock Exchange ill, but this has become such a commonplace as to excite no comment.

Electricity Supply shares are rather harder, but the volume of buying orders is very meagre. The severe falls in such high-class descriptions as St. James's and Westminsters have brought in comparatively few buyers. Certainly, outside investors have come along to a slight extent, but the people who, in days gone by, could always be trusted to support the market, are no longer purchasers. The stockbroker who happens to be a Free Trader, skirts the electric lighting market unless he has an order: "your Radical friends" is a compliment concealing a bitterness perhaps not unnatural in view of the London County Council's Power Bill, which, by the way, is fully expected to go through Parliament.

Descending to details, Charing Cross Preference crumbled ⅜ to 4¾ upon a few selling orders. Edmundson's gave way ¼ to 4¼, and there is no doubt that the company's connection with the Lancashire Power undertaking, known or not to Edmundson proprietors, is acting as a drag at the present time. Kensingtons at 9¾ are ¼ lower, but Metropolitans rose 10s. after digestion of the chairman's speech at the meeting. Chelseas are ⅛ harder, and London Electrics ¼ down. Oxford shares recovered the ¼ shed last week, and Hove are a shade firmer at 8¾. Possibly the new Bournemouth and Poole Second Preference will be issued at 11. New County Preference went fairly well, the underwriters not being left with more than about 25 per cent. The Lancashire Tramways issue begins to assume definite shape.

Further weakness in Metropolitan Railway Consolidated stock has lowered the price to 77½, and even at that there are not many buyers. The company's delay in the complete electrification of its lines is seriously prejudicing the price of the stock. Some people seem to think the new Baker Street and Waterloo Railway will act to the disadvantage of the Metropolitan Railway instead of serving it as a feeder. But the greatest competitor of all the railways this summer will be the motor-buses. District stock fell to 29. Great Northern and City Preferred "A" shares are nominally ¼ down at 4⅜, while Central London Deferred rose a point to 83½. A full three points has been shorn off Waterloo and City Railway Ordinary, the price dropping to 99½. No alteration is likely to be made in the terms already put forward by the South-Western Railway.

By slow degrees the steam companies are electrifying their suburban systems, and the Great Northern is apparently only waiting for the St. Neots power scheme to be passed, to start upon its local lines. Several others have made a beginning, and in course of time the steam engine will, no doubt, become a mere curiosity in suburban traffic.

Industrial stocks and shares are better on balance. British Aluminium Ordinary and Preference improved, and Brush shares slightly hardened in tone upon the return of the Ordinary to the list of dividend-payers, after some six years' absence. Callender's are 10s. easier, and the Willans & Robinson trio is very weak, both classes of shares falling ¼, and the Debenture stock 2 points. Bruce Peebles makes a good showing, and pays an additional ½ per cent. dividend, making 6½ per cent. The Preference shares keep at 5⅛, and seem to be a very fair investment, carrying 6 per cent. cumulative interest. The Electrical Development Company of Ontario 5 per cent. bonds are being offered at 96½ per $500 bond. General Electric Debenture is a point lower at 96. Henley's 4½ per cent. Debenture is 109 for the fully paid and 58 for the partly paid.

Some bidding for Marconi Wireless Telegraph shares was sufficient to put up the price of the new to 2s. 6d. premium. Whether the buying came as a little incentive for allottees to apply for their shares we cannot say, but it coincided singularly with the last days upon which proprietors in Great Britain had to send in their applications. The old shares are ⅛ up at 1¼. Direct United States shares rose ¼ to 15⅜, and a dividend of 4s. has been declared. The Anglo-American Telegraph group weakened, but West African Telegraph shares at 10 are ½ up. Telephone issues are all unchanged.

British Electric Tractions advanced ⅛ to 7⅜, and Anglo-Argentine Tramway Ordinary are good at 9⅛ upon the approach of the bonus to be given in the new shares. Potteries fell ¼. Metropolitan Electric Trams Deferred drooped to 4s. 4½d. middle

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations March 14th.	Closing Quotations March 21st.	Business done week ended March 21st, 1906. Highest	Lowest.	Rise + or Fall —
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	98¼—101½	98½—101½	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3¾— 4¼	3¾— 4¼	81/3	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	83 — 88	83 — 88	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	23%	31%	65½ — 67½	65⅝ — 67½	65⅝	..	..
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5%	6 %	113½—114½	113 —114	114⅛	113¾	— ½
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	1%	20¾— 20⅞	19⅜— 19⅝	20⅜	19⅛	— ½
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	103 —105	101 —103 xd	..	..	—2
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	8 — 8¼	8 — 8¼	8⅝	8¼	..
1,932,856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	97⅛— 98⅛	97⅛— 99⅛	98⅜	97⅛	+ ½
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %	8⅜— 9	8¼— 9	8⅝	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18	17 — 18	..	..	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	8¾— 9	8⅜— 9	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 —103	100 —103 %	..	..	..
60,710£	Direct United States Cable	20	3½%	3 %	3½%	3½%	15½— 15⅝	15½— 16	15⅝	15½	+ ⅛
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99½—101½	100 —102	..	..	+1 ½
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	5 %§	147 —150	147 —150	148⅝	147½	..
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%§	90 — 92	90 — 92	91⅛	90½	..
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %§	107½—109½	107½—109½	109	108⅝	..
800,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	6 %§	15 — 15⅛	15⅛ — 15⅜	15⅜	15⅛	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %§	105 —107	105 —107	106⅝	106	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	101 —103 %	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	5 %	11¼— 11⅜	11¼— 11⅜	11 1/16	11¼	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜— 15	14⅜— 15	15	14⅜	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	..	38 — 40	38 — 40	38⅜	..	..
42,300	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99½—101½	100 —102	101	100	+1
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	5 %	57 — 59	57 — 59	..	..	..
251,127	Marconi's Wireless Telegraph	1	..	..	..	..	1 — 1¼	1⅛— 1⅜	24/9	21/6	+ ⅛
72,680	Monte Video Telephone Co., Ltd. Ord.	1	8 %	8 %	4 %	..	⅞— 1	⅞— 1	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞— 1	⅞— 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	110 —111 xd	110 —111	110⅝	110	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	112 —114 xd	112 —114	113½	112	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12 — 14 xd	12 — 14	13	12	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½ — 12½xd	10⅝ — 12⅝	11⅛	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅛— 5⅜xd	5⅛— 5⅜	5⅜	..	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 —101	99 —101	100	99¼	..
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 —105	103 —105	104⅛	103¼	..
173,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¾%	6¾%	6 %	1¼— 1⅜	1¼— 1⅜	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1¼— 1⅜	1¼— 1⅜	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	98	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 %§	7¼— 7¾	7¼— 7¾	7¾	7⅞	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 —106	103 —106	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	128 —131	128 —131	130½	129	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7¼— 7½	7¼— 7½	..	..	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 —112	110 —112	..	..	..
15,669£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9½— 10	9⅞— 10⅛	..	..	+ ⅛
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	100	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14½ — 15	14½ — 15	14⅝	14⅛	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	100 —102	100 —102	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —104	102 —104	..	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8½— 8¾	8½— 8¾	8⅝	8½	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6¾— 7¼	6¾— 7¼	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007 ..	5	..	..	8 %	6 %§	8⅞— 9¼	9 — 9¼	9 3/32	9	+ ⅛
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅞— 6⅛	5⅞— 6⅛	6 1/16	6	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	141 —144	141 —144	143	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 —106	104 —106	105½	..	..
800,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	16 %‖	4 — 4⅛	3⅞— 4⅛	82/6	78/9	— ⅛
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	..	..	2 — 2⅛	2 1/16— 2 1/16	43/9	..	+ 1/16
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	Nil	3/6	5⅜— 6⅛	6 — 6⅜	6⅜	6⅛	+ ⅛
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	3/-	5 — 5⅛	5 — 5⅛	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2⅞— 3⅛	2⅞— 3⅛	..	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	98 —102	98 —102	..	..	..
800,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	..	120 —123	120 —123	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	..	110 —113	110 —113	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	108 —111	107 —110	107½	..	—1
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 —105%	103 —105 %	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 —105	102 —105	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	7 — 7⅛	7⅛— 7⅜	7⅜	7 1/16	+ ⅛
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %§	9¼— 10⅛	9⅛— 10	9⅞	9⅜	..
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	117 —120	117 —120	119	..	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	98 —100	97 — 99	98¼	..	—1
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6⅞— 7⅛	6⅞— 7¼	..	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅞— 6⅛	5⅞— 6⅛	6 1/16	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	103 —106	103 —106	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	96 — 98 xd	96 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞— 2⅛	1⅞— 2⅛	41/10½	..	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 — 85	* 80 — 85	82	81½	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	Nil	2½%	¾— 1	¾— 1	14/4½	..	..
150,000	Do. Non-cum. 6 % Pref... ..	2	6 %	6 %	6 %	6 %	1½— 2	1½— 2	33/1½	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	82 — 84	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	..	3⅛— 3⅜	3⅛— 3⅜	75/-	73/9	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	..	5⅛— 6⅛	5⅛— 6⅛	6 1/16	6	..
27,500	Do. "B" do. 1 to 27,500	5	..	6 %	6 %	..	5⅛— 5⅜	5⅛— 5⅜	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 —108	106 —108	107⅛	107	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	104	103½	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	7 %§	9⅛— 10⅛	9⅛— 10⅛	..	..	..
32,610	Do. 105,001to 137,610	5	..	..	..	3d.	9 — 9⅛	9 — 9⅛	9 1/16	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4 %	4½%	106 —108	106 —108	107⅛	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10%	11 — 12	10⅛— 11⅛	11	..	— ⅛
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅝— 6	5⅝— 6	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108⅛—110½	108⅛—110½	109⅛	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅞— ¾	⅞— ¾	15/7½	13/9	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	..	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 —100	95 —100	..	..	..
1,989,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	91 — 93	91 — 93	92½	91½	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	103½	103¼	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	81 — 84	82 — 85	..	..	+1
1,480,000	City and South London Railway	Stock	3½%	2⅜%	2⅜%	1⅞%	41 — 43	41 — 43	..	..	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	2½%	..	2⅞— 2¼	2 — 2¼	42/6	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98 %	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Mar. 14th.	Closing Quotations Mar. 21st.	Business done week ended Mar. 21st, 1906. Highest	Lowest.	Rise + or Fall—
52,000	Dick, Kerr & Co., 1 to 52,000	† 5	..	..	10 %	..	8½ — 9¼	8½ — 9¼	..	..	..
61,000	Do. do. 6 % Cum. Pref., 1 to 61,000	5	..	6 %	6 %	6 %	6 — 6½	6 — 6½	6⅜	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	104 —106	104 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	13⅜ — 14⅝	13⅜ — 14⅝	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14½ — 15¼	14½ — 15¼	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	39¼ —100½	99½ —100½	..	..	..
800,000	Do. 3½ % "A" Debs.	100	..	3½ %	3½ %	3½ %	100 —100¾	100 —100¾	..	..	..
800,000	Do. 3½ % "B" Deb. Stock	100	..	3½ %	3½ %	3½ %	97 — 97½	97 — 97½	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½ %§	..	1⅜ — 1⅝	1⅜ — 1⅝	36/10½	..	..
17,189	Do. "A" shares, 01—017,189	5	Nil	Nil	2½ %§	..	2½ — 3	2½ — 3	..	..	..
844,023	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	92 — 97	92 — 97	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	1/16 — 3/16	1/16 — 3/16	12/6	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,890	2	7 %	7 %	7 %	..	2 — 2⅛	2 — 2⅛	43/9	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9⅛ — 9⅞	9⅛ — 9⅞	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	95 — 99	94 — 98	..	..	—1
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	4½ — 5	4¼ — 4⅝	..	..	— ⅛
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10¾ — 11¼	10⅜ — 11⅛	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —103	102 —103	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12½ — 13¼ xd	12½ — 13¼	13	12⅝	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5¼ — 5⅝	5¼ — 5⅝	..	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	.. — ..	.. — ..	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10 %	5 %	10%	17½ — 18½	17½ — 18½	18⅜	17½	..
800,000	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	12½%	12½%	12½%	Nil	1⅞ — 1⅞	1⅞ — 1⅞	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6½ — 7	6½ — 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	9 — 9¼	7⅞ — 8⅛xd	..	..	..
399,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	3 %	3 — 4	2 — 3 xd	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	9 — 9¼	9¼ — 9⅜	9⅛	9⅛	+ ⅛
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	93 — 96	95 — 98	97	..	+2
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	..	7/16 — 9/16	5/16 — 1/2	..	..	— 1/32
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1⅛ — 1⅛	1⅛ — 1⅛	..	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	104—106	104 —106	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	5 — 5¼	5 — 5¼	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	..	8½ — 9	8½ — 9	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	9¼ — 9⅝	9 — 9½	..	..	— ¼
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 — 106	103 —106	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	32½ — 34½ xd	32⅛ — 34½	32⅞	32¼	..
150,000	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	98 — 100	98 —100	98½	..	—3
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	101 — 104	98 —101	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8½%	6 %§	..	..	2½ — 2⅝	2 — 2⅛	47/9	..	— ¼
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	..	..	4 — 4½	3½ — 4¼	80/-	..	— ¼
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	82 — 87	80 — 85	..	..	—2

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5½%	4 %§	5½ — 5⅝	5½ — 5⅝	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8½ — 9¼ xd	8½ — 9¼	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	8½ — 9¼ xd	8½ — 9¼	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	102 —105	102 —105	103½	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4⅞ — 5⅛	4⅞ — 5⅛	5 7/16	5⅛	— ⅛
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅝ — 5⅛	4⅝ — 5	5	95/-	— ⅛
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4¼ — 4⅝	4¼ — 4⅝	..	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	4¼ — 4⅝	4¼ — 4⅝	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	102⅛	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5½ — 5⅝ xd	5½ — 5⅞	5⅞	5⅛	+ ⅛
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	107 —109	..	..	—1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10⅞ — 11⅜	10⅞ — 11⅜	11¼	11⅛	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	13½ — 14¼	13½ — 14¼	13⅛	13⅛	..
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	125	124⅛	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..
50,000	Do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8½ — 9⅛	8½ — 9⅛	9	8 13/16	..
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	12⅜ — 12⅝	12⅜ — 12⅝	12⅛	..	..
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	111	110¼	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —103	102¼	102	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5 %§	4¼ — 4⅜	4 — 4⅛	89/9	85/-	— ¼
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	5⅜	5 7/8	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	104 —106	104 —106	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	4 %§	5¼ — 5⅜	5¼ — 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	8⅜ — 8⅝	8¼ — 9	..	..	..
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	9 %	8 — 8⅜	8⅛ — 8⅜	..	..	+ ⅛
37,303	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	97 — 99	98 —100	..	..	+1
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	97 — 99	98 —101	..	..	+1½
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½	12½	10 %	9½ — 10¼	9¼ — 10¼xd	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	2¼ — 2⅜ xd	2 — 2⅛	47/6	45/-	— ¼
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5¼ — 5⅜ xd	5⅛ — 5⅜	5⅜	..	— ⅛
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8¼ — 9⅛	9 — 10	9 7/8	9¼	+ ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅜ — 5⅝	5⅜ — 5⅝	5 1/8	..	..
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	96⅜	96	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	101 —103	101 —103 %	102¼	..	..
57,009	Newcastle-on-Tyne, 1 to 57,009	5	..	8 %	8 %	8 %	8 — 8¼	8 — 8¼	..	..	..
17,991	Do. 57,010 to 75,000	5	..	..	..	8 %	8 — 8¼	8 — 8¼	..	..	..
57,009	Do. 5 % Pref., 1 to 57,009	5	..	5%	5	5 %	6⅜ — 6⅝	6⅜ — 6⅝	..	..	..
17,991	Do. 57,010 to 75,000	5	..	..	..	5 %	6⅜ — 6⅝	6⅜ — 6⅝	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13 — 14 xd	13 — 14	..	..	..
64,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6¼%	7 %	7 %	6¼ — 6⅜ xd	6½ — 7	6⅝	6⅝	+ ⅛
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	99 —101	..	..	+1
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	9¼ — 10¼	9¼ — 10¼	10	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	96 — 98	96 — 98	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2¼ — 2⅜	2¼ — 2⅜	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	13½%	3 %	4 %	4 %	3⅛ — 3⅜	3⅛ — 3⅜	3 7/8	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	1/16 — 1/8 xd	1/16 — 1/8	..	..	..
85,868	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1⅛ — 1⅜ xd	1⅛ — 1⅜	..	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	4⅛ — 4⅜	4⅛ — 4⅜	4⅛	..	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5 1/8	5⅛	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	104 —106	104 —106	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	18 %	9¼ — 10⅛ xd	9¼ — 10⅛	10⅛	9 1/8	..
28,151	Do do. 4½ % Cum. Pref. (Originally 5 %—Red. to 4½ % from 31st Dec., 1905.)	5	5 %	5 %	5 %	5 %	5 1/16 — 5⅛	5 1/16 — 5 1/8	5⅛	5⅛	..

Shares not officially quoted :—Mackay Companies, ord., 61—62. Pref. 75½—76½.

† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 4 per cent (September 28th. 1905).

THE KEEPING OF CONSUMERS' RECORDS IN ELECTRIC SUPPLY UNDERTAKINGS.

By R. C. W.

In most electric supply undertakings, that part of the book-keeping which relates to consumers' records, although of much importance, is often one of the most neglected, and the following description of a system which has been found by the writer to be very successful may be of interest to those who are responsible for this part of the routine work of an electric undertaking.

It will, perhaps, be the best plan to begin with the consumer's application for supply. This is very often left by the consumer for his wiring contractor to fill in, and on this account it should be seen that it is signed by the consumer himself; or in the case of a new house not tenanted, by the builder or owner of the property. In conjunction with the application form, there should be some of the more important rules and regulations relating to the conditions of supply. The writer would recommend that the application form be made up in the form of an agreement which, if necessary, could be stamped. Of course, this extreme would only be resorted to under certain circumstances, or in the case of consumers from whom trouble was anticipated.

The application form should state clearly for what purpose a supply is required, *i.e.*, lighting, heating, power &c., and in the case of lighting, the number of lamps of each candle-power or size of arc, and Nernst lamps, should be thus enabling the consumer to retain a copy for future reference if required.

Let us now assume that the consumer has filled up the application form, signed and returned it to the electric

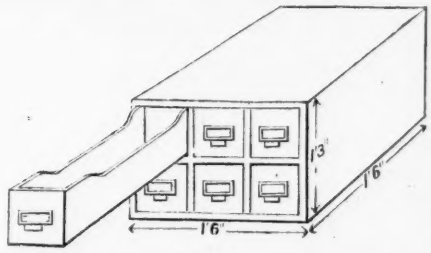


Fig. 3.

supply authority, either company or municipality, as the case may be. On being received it is, if in order, passed by the chief engineer or manager, and handed on to the mains department, who, in the system being described, are responsible for all the consumers' records, excepting, of course, the

Application for Supply of Electricity for Lighting, &c.

NAME OF UNDERTAKING HERE.

To (Name of undertaking here)

Please supply electricity to the premises, and for the purposes, below mentioned upon the terms and subject to the regulations endorsed, to which I hereby assent.

Incandescent lamps	Candle-power	8	16	25	32		New consumer
	Number fixed						Extension or re-connection
Nernst lamps	Current						
	Number fixed						
Arc lamps	Current						
	Series or parallel						
	Number fixed						
Other apparatus	H.P. or current						
	Number fixed						
	Class of work						

Name of wiring contractor.....

Address .....

Signature of applicant .....

Premises to be supplied .....

Date 190

P.T.O.

Fig. 1.

Name :—								
Address :—								
Date	Meters				Indicators			
	Size	Make.	Volts	No.	Size	Make	Volts	No.
Date	Motor or Transformer					Purpose required for		
	Size	Make	Type	Volts	No.			

Fig. 4.

Date of Application.....										
Date connected										
Date	Incandescent Lamps				Arcs		Nernst		Demand in Amperes	Equivalent in 8 c.p. Lamps
	8	16	32		No.	Size	No.	Size		
General Remarks :—										

Fig. 4A.

Date	Name	Address	Particulars of Service	Main connected to	Meter				Indicator			Motor or Transformer			Lamps								Wiring Test	Jointer	Polarity
															Incandescent				Arcs		Nernst				
					Size	Make	Volts	No.	Size	Make	No.	Size	Volts	No.	8	16	25	32	No.	Size	No.	Size			

Fig. 2.

tated. Above is given a type of application form, which has been found by the writer to be quite satisfactory. (See fig. 1.)

On the back of the form are printed some of the more important rules and regulations of the undertaking. If deemed necessary, this form can be made up in duplicate, clerical work in connection with the taking of meter readings and the sending out of accounts. Here the name and address of the consumer, together with full particulars of his demand, &c., are entered in a book which is kept for the purpose, and the application form is returned to the office and duly filed away.

The installation being completed, officially tested and connected to the mains, full particulars of the service, main connected to and particulars of meter, &c., are entered by the mains foreman or installation inspector in a special book which is made out as shown in fig. 2. This book is returned to the official who is responsible for the consumer's record at the end of each week, or at such time as the final entries

Address :—							
Name :—				Supply required for :—			
Distributor connected to				Particulars of Service			
Points		Demand		Wiring Test	Contractor	Jointer	Date
+	−	+	−				

Fig. 5.

are recorded. These are made on what is now well known as the "card system." This system, in the opinion of the writer, is one which is eminently suited to the keeping of consumers' records, being much more flexible than any system in which books only are used. Briefly described, it is as follows :—

Fig. 3 is a sketch of a cabinet, in which are fitted a number of drawers, in this particular case six, and the dimensions are approximately as shown.

Each drawer is capable of holding 1,000 cards, which measure 6 in. × 4 in., and contain the particulars shown in figs. 4, 4A and 5. Fig. 4A is the reverse side of fig. 4. Each consumer has two cards allotted to him, one of which we will call the installation card, as shown in figs. 4 and 4A, and the other the mains card, shown in fig. 5.

The installation cards, which are arranged in alphabetical order, are kept entirely separate from the mains cards in different drawers. In order to simplify the location of any particular consumer amongst the installation cards, what may be termed index cards are used. These take the form shown in fig. 6, and consist of a blank card the same size as the others, but having a tab which stands above the other cards, and on which are printed the initial letters of consumers' names, whose cards are placed behind that particular index. For instance, in the example shown, "Aa — Bz" is shown on the index tab, and behind this card would be placed those consumers' cards, the initial letters of whose surnames came within that category. The next index card

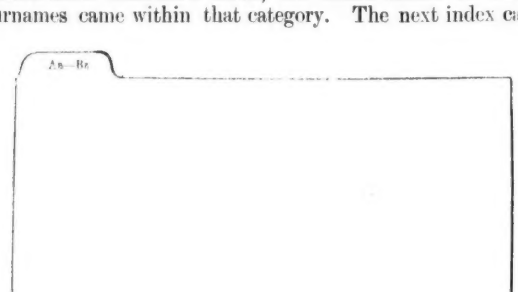


Fig. 6.

might be "Ca — Cz," and so on. By this means it is a simple matter to locate any particular consumer's card amongst hundreds of others.

Regarding the mains cards, these are indexed, but in a different manner, inasmuch as instead of the tab being alphabetical, there are inscribed on the tabs the names of the feeders or distributors. As an example, we might first have a card with a tab, as shown in fig. 7. On the tab of this card would be written the name or number of any particular feeder, and on the remainder of the card would be full particulars as to the size, type, make, and the route taken by the feeder. Behind this would be placed another card with a tab similar to, but longer than, the one shown in fig. 6. On this tab would be written the name of one of the distributors of the feeder behind which it is placed, and on the rest of the card would be particulars as in the case of the feeder card. Behind the distributor card would be the consumers' mains cards in street and house order. Each distributor of that particular feeder would be so treated, and then another feeder tab card placed behind the lot, and its distributors filled in, in the same way.

It will be seen that by this method of filing it is at once possible to find at any time the total number of consumers on any particular feeder or distributor, and if it should happen that a distributor be fed at any time by a feeder other than the one which originally supplied it, all that is necessary to keep the system up to date is to take the cards concerned and place them behind the right feeder, thereby doing away with any of the crossing out or making of fresh entries, which would be necessary with almost any system of books, and which would most probably take considerable time. In the case of continuous current three-wire systems, in order to indicate clearly the polarity of any particular consumer's service at a glance, differently coloured cards may

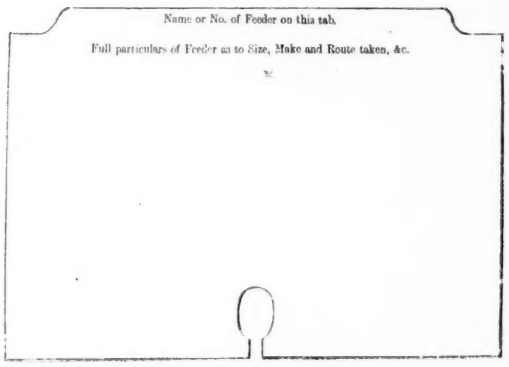


Fig. 7.

be used. Thus a consumer who was connected to, say, the positive side, would have a red card allotted to him, and one who was on the negative a blue, while a consumer who had a three-wire service would be represented by a white card. There are, in fact, many ways in which consumers' cards may be discriminated which do not alter the system as a whole, and which may, or may not, appeal to different people.

In conclusion, the writer would say that he has found the above method of keeping consumers' records most satisfactory, and is of opinion that for simplicity and flexibility, which latter, by the way, is in this case a very important point, it cannot be beaten.

THE ROYAL COLLEGE OF SCIENCE.

A few weeks ago the final report of the Departmental Committee appointed nearly two years ago to "inquire into the present working of the Royal College of Science, including the School of Mines," and to consider in what manner the present and future staff, buildings, and appliances may be utilised to the fullest advantage for the promotion of higher scientific studies of a technical or technological character, presented its final report. About a year ago a preliminary report was issued, in which it was stated that the Board of Education had been approached with reference to the support and assistance that body might be disposed to give if a suitable scheme could be evolved for the future control of the "Royal College of Science, with which is incorporated the Royal School of Mines"—to give the existing institution its full title. It was felt at the time that the attitude

of the Board should be ascertained and defined before the Committee could elaborate the details of its proposal; and this having been done to the satisfaction of all parties, the present report is published. Except in a few minor matters, the members of the Committee are unanimous in their views, and therefore the report has been signed by all the present members of the said Committee, their names being:—

Mr. R. B. Haldane, K.C., M.P.; Sir Francis Mowatt; Sir W. de W. Abney, F.R.S.; Sir William S. Church; Mr. A. H. Leech; Sir Philip Magnus, M.P.; Mr. Walter McDermott; Mr. F. G. Ogilvie; Lord Reay; Sir Arthur W. Rücker, F.R.S.; Mr. Sidney Webb; Sir Julius C. Wernher; Sir William H. White, F.R.S.; Mr. J. C. G. Sykes (secretary), and F. E. Douglas (assistant secretary).

Strictly speaking, the present report is only Vol. I., because a second volume containing minutes of the evidence taken, other appendices, and an index, remains to be issued; but practically the first volume includes everything that the reader who is not immediately interested in the daily proceedings of the Committee can want to know.

The major portion of the report is taken up with a review of existing organisations for providing technical instruction in this country, Germany, Switzerland, the United States, Canada, France, and Belgium; and should be most useful to all who have not kept themselves acquainted with the opinions expressed during the past few years by responsible writers in the "heavy" technical and general Press. Even to students of such literature, and to the authors thereof, this first portion of the report is interesting and gratifying, because it places the seal of independent approval upon the assertions made and the arguments used. For instance, the Committee states "that the position of this country makes further provision for advanced technological education essential;" that students are not obtaining it to the desired extent for several reasons, including "an insufficient appreciation, especially on the part of employers, of the value of such education." Elsewhere it is remarked that the main obstacle to the advancement of higher education in England has hitherto been the attitude of the employer and of the parent, but it is added that the attitude of both "has changed materially in the last few years." The Committee also says that the inadequacy of the opportunities for research in existing technological institutions is due, not to lack of ability on the part of the professors, but to the circumstance that much of their time is taken up in offering comparatively elementary instruction in science.

Within the scope of a brief article it is hopeless to give an abstract or even fair indication of the recommendations made by the Committee; they extend over 40 paragraphs, and must be read in the original or in *The Times* of February 5th, where they occupy nearly three columns of small print.

The time for the publication of the report is most opportune. Subject to their satisfaction with the details of the scheme, the Board of Education is prepared to place at the disposal of the institution the existing and still unfinished buildings at South Kensington, now used by the college, to help largely in their maintenance, to pay the rates, and to make an annual grant of £20,000. The commissioners of the 1851 Exhibition are willing to grant the unoccupied portion of their South Kensington estate. Messrs. Wernher, Beit & Co.'s offer of £100,000 for capital expenditure made some three years ago through Lord Rosebery, is available, and so are certain moneys from the Bessemer Memorial Fund. The London County Council will probably grant an annual sum up to £20,000 for current expenses, so that the financial future of the new scheme should appear largely secured. Hence the Committee hopes that it may be feasible to effect "the establishment of an institution or group of associated colleges of science and technology, where the highest specialised instruction should be given, and where the fullest equipment for the most advanced training and research should be provided in various branches of science, especially in its application to industry, for which no sufficient provision already exists elsewhere." Subject to necessary adjustments, the scheme should "include the work of the Royal College of Science, the Royal School of Mines, the Central Technical College, and departments to be established on the additional site at South Kensington. The governing body should be composed of forty members, six appointed by the Crown, four by the Board of Education, five each by the University of London, the L.C.C., and the Council of the City and Guilds of London Institute, four by the teaching staff of the Institution itself, and one each by the Royal Society, the three leading Engineering Institutions, the Iron and Steel Institute, the Institution of Naval Architects, the Society of Chemical Industry, the Federated Institution of Mining Engineers, and the Institution of Mining and Metallurgy. We do not desire to quibble, but we feel that in the department of chemistry, the Institute of Chemistry should be the (or a) representative of that branch of applied science, because the body in question is better qualified, and is the main qualifying organisation, especially since it has undertaken to hold examinations in technological chemistry. It is unanimously felt that the governing body should get to work without delay, but some difference of opinion exists as to the future relations of the new Institution to the University of London, and whether a Royal Commission should be appointed to consider what changes, if any, should be made in the constitution of the University with a view to ultimate amalgamation.

There cannot be the slightest doubt that if the recommendations of this committee are followed, they will result in a successful creation of "the chief Technical School of the Empire," or that the new Institution will prove of incalculable benefit to the nation. Since the time, some few years back, when everybody discovered what the true technological needs of the British race were, and when the lay journalist found that the millennium of applied science teaching had already arrived in Germany and the United States, there has been something of a reaction. It has been pointed out that the system that prevails in Germany, admirable as it may be for Germany, is not fit for transplantation to British soil: and the Departmental Committee takes care to endorse the latter opinion. But it has also been urged that posts are not to be found for the ever-increasing number of scientifically or technically-trained students turned out by existing institutions. This view, as we have endeavoured to show on previous occasions, is inaccurate unless guarded with important qualifications. Badly or insufficiently trained students in all departments of applied science, or students who have received a veneer of intrinsically good training upon a rotten substratum of schooling, do not find posts, or only find posts where the remuneration appears small; but fully-equipped, post-graduate students are snapped up by our manufacturers in growing numbers; and they are paid in a fashion approximately commensurate with their actual abilities. In one branch of science, viz., chemistry, we observe that numerous "chemists" are out of work, but that applications by our leaders of industry for suitable men who hold the Fellowship of the Institute, are often made in vain.

BRAKES.

The *Official Circular* of the Tramways and Light Railways Association for February contained the discussion of Mr. Fell's paper on "Brakes," and the author's reply. It contained also the paper itself, but we have dealt with that already.

Sir Wm. Preece was enthusiastic in his praise of the paper, dubbing it classical, as we think it may become. He put a question to Mr. Fell which brought an exceedingly important answer—an answer which does more for electro-magnetic braking than any fact which was the outcome of the tests. He asked how long an interval elapses between the action of moving the brake handle and the commencement of the act of braking, and he reminded the audience that the interval is appreciable on trains which are braked by any of the non-electrical ways. Mr. Fell was able to bring the charts of his recording instruments to prove that there is no discernible interval at all with any of the magnetic brakes which were tested. That can never be the case with any other kind of brake whatever. Hand power, steam, positive or negative

air power, cannot in the nature of things be applied instantaneously, although that attribute is of immense importance under all circumstances which involve the peril of life and limb. Important on a railway, the quality of instantaneity becomes a question of the first magnitude on a tramway where the public is not fenced off from the lines.

The tests were undertaken with the primary object of demonstrating in a tangible and irrefutable manner that higher speeds than the maxima permitted at present may be allowed with equal safety directly the best known form of brake is fitted; and Mr. Fell has demonstrated to the world what many of us have known, and what the Electrical Review has held, for some time; he has shown that the best all-round brake is the electro-magnetic, and he has proved what perhaps we did not realise so well before—that this class of brake is not only the best, but is far in front of any other.

Henceforth we may leave out of comparative tests every form of hand brake, whether it acts on the wheels or on the rails, and we need consider merely the types which find their force of application in the regions of air, steam or electricity; and, although no type of air-brake was included in the L.C.C. tests, we do not know that the omission matters much, so long as the simple forms of electro-magnetic brake which were tried gave highly satisfactory results, for we incline to believe that nothing but the electro-magnetic brake will supersede the present forms of hand brake on electric tramcars, unless some really economical and compact stored air system is developed. Even then the magnetic brake will take much ousting.

The discussion, both spoken and written, was little but a fight between the champions of the "A" brake and the champions of the "B" brake. We have no desire to identify ourselves with either side, as, of course, deep commercial interests are involved, but we cannot refrain from saying that a study of figures and curves, which no doubt has not been so sustained and analytical as the study which Mr. Fell has made of them, does not leave us with an entirely clear idea of the reasons which led Mr. Fell to deliver a verdict which is in effect in favour of the "A" type. We suggest to all who are interested in the matter that they should digest the paper themselves, rather than swallow the pre-digested summary after the ruling gastronomical fashion.

Types "A" and "B" are alike up to a point. Both have magnetic slippers, but "A" stops there while "B" links the slippers on to the wheel blocks and gets a pull transmitted from slippers to blocks, which is in direct proportion to the speed of the wheels.

Until Mr. Fell read his paper we favoured the simpler form for practical reasons backed by certain results of which we had cognizance, but now we feel that the position is changed, and that the "A" type will have to show very marked practical advantages to out-balance the better showing of the "B" type in retardation and motor heating.

The conditions of these tests were admirable in all but one thing, the rail surfaces were not alike for tests in which equality in this respect is essential to true comparison. It is easy to urge that ideal laboratory conditions cannot exist under such circumstances as brake trials on the open road, and to that the only reply is that the ideal conditions ought to be approximated so far as human ingenuity and existing appliances permit, and that in the particular case of these brake trials the results would have stood a greater chance of becoming classical and of being a real help from beginning to end if the greatest possible care had been taken to keep the rails in the same condition for tests which were intended to be similar in every way. Too much praise cannot be given to the delicate accuracy of the records, but a stronger spicing of that accuracy might have been given to the very groundwork of those records.

It is not as arm-chair testers that we suggest that the head of a rail may be kept in equable condition within close limits, if rail cleaners and a water car are employed, and that the best way to simulate a greasy rail for testing purposes over any number of nights is to grease or oil the clean surface of the rail in some way which would ensure fair uniformity. Mr. A. H. Pott mentioned, in discussion, that he had taken independent tests after this fashion, and we think he was working in the right direction by clearing the bases of his tests from suspicion.

It is quite possible that careful procedure of this nature would increase the time taken by a series of tests, but that is a minor consideration whenever the highest accuracy is wished.

Mr. Sayers raised the objection to braking with iron shoes on the rails that the wear of the rail head will be a serious item. He is not alone in this opinion, but we do not feel competent to express any definite views on a matter which has not been investigated with sufficient attention. It is a matter which involves the greatest difficulties, as the wear due to normal causes and to brakes must be differentiated.

Next time Mr. Fell or anyone else undertakes a series of brake trials we should like to see the effects of sand noted.

PROCEEDINGS OF INSTITUTIONS.

Available Power and Cost of Operation of a Power Station for Waste Gases from a Blast Furnace Plant.

The above is the title of a paper lately read before the Western Society of Engineers (American) by Mr. H. Freyn, an abstract of which appeared in the *Electrical Review*, New York, and as it treats of a subject that has frequently been brought before our readers during the last 10 years, any additional side lights will be appreciated. The writer bases his calculations on a new blast furnace plant consisting of two furnaces capable of producing 400 tons each per day.

In regard to this output, many blast furnace managers in this country will be doubtful as to the expediency of putting *so many eggs into one basket*; but, of course, that is only a matter of detail. However, it may be pointed out that it is not necessary from the utilisation of the gases point of view, that such large capacity furnaces should be employed, for in this connection the larger the number of furnaces from which the gases are to be taken, the better, as then the stand-by provision is reduced.

With both furnaces working well and using 1,900 lb. of coke per ton of pig-iron, the gross production of gas per 24 hours is given as 110,000,000 cb. ft., an estimate which is somewhat less than that of many other writers, being little over 160,000 cb. ft. per ton of coke consumed. The loss of gas at the furnace top is taken at 5 per cent.; this might be about the figure when the most modern type of charging hopper is employed, but would probably be exceeded at those furnaces, which are open to the atmosphere when the bell is lowered to admit the charge. At the figures given the total volume of gas per hour available for all purposes comes to 4,350,000 cb. ft., having a heat value of 391,500,000 B.TH.U., and allowing 9,000 B.TH.U. per B.H.P.-hour for gas engines working at *full* load, this is equivalent to 43,500 H.P. This power could only be developed while the *blast* was on the furnaces and the full load on the gas engines, both of which conditions are never likely to be continuous.

Mr. Freyn then goes on to deal with the power requirements of the furnaces themselves, which must, of course, be deducted from the gross power available. The furnaces could not produce 1 ton of iron with only 1,900 lb. of coke unless hot blast was employed, and this heating of the air supply is in present practice effected in stoves, which are heated by the combustion of a portion of the waste gases.

The question as to whether it might not be more economical, in the case of a new furnace plant purposely designed to obtain the maximum economy from the gaseous effluent, to use producer gas made from common coal slack to heat the stoves, so as to leave the furnace gases available for gas engines in the power station, has not been put to practical test, but this scheme appears to be well worthy of consideration on account of the fact that at those periods during which one or other of the furnaces was off blast, and therefore producing no gas, the producer gas could be diverted from the stoves to the engines, through the cleaning apparatus required for the furnace gases, to keep the power station up to full requirements.

At the same time the efficiency of the stoves would be increased through there being no deposit of dust from the ordinary blast-furnace gases, and therefore greatly reduced charges for cleaning stoves as well as stand-by charges for stoves that have to be put off duty for cleaning would result.

Mr. Freyn goes on to show that, of the total quantity of gas evolved and available, about 50 per cent. will be required to provide for the furnaces themselves.

At this stage, in the absence of detail figures by Mr. Freyn, we may turn to those given by Mr. F. du P. Thomson,* where he allocates the distribution of the gases to the various purposes as follows:—

Heating the blast	18·0 to 33	per cent.
Compressing the blast ...	16·5 „ 20	„
Auxiliaries	3·5 „ 5	„
Surplus available	52·0 „ 42	„

The above figures are dependent upon the gases being used in gas engines except in the case of that portion required for heating the blast.

* *Electrochemical and Metallurgical Industry.*

In a careful estimation made by the writer, the proportion of the gases necessary to be used to raise the temperature of the blast was found to be 25 per cent., so that, as far as regards the time that the furnace is in blast, about one-half of the evolved gases can be reckoned on as available for profitable power development.

Both Mr. Freyn and Mr. Thomson go into the question of the continuity of the supply of gas from the furnaces under the ordinary working conditions of this class of apparatus on different lines, and this is the crux of the whole question.

The blast furnace gives off its gas during the whole 24 hours of the day, "with the exception of such times as it is necessary to turn off the supply of blast to meet the requirements of the smelter who has charge of the furnace."

Mr. Freyn refers to such times as the conditions of trade requiring the furnace to be "banked" or closed up without any blast supply for a more or less lengthened period, and Mr. Thomson deals with similar conditions; but these are really not so important as the frequent stoppages occurring during the operation of smelting.

If the available supply of gas is so applied to developing power that it becomes a source of profit outside the manufacture of iron, then, unless the furnace had to be stopped for relining, during any temporary condition of trade rendering a stoppage in the production of iron advisable, the furnace could be charged with coke only, thus becoming a simple gas producer for the time being, or, where there is an auxiliary gas producer, the power supply could be maintained without great loss.

Apart from these interruptions in the production of gas, there are others intermittently occurring during the operation of smelting. In most of the furnaces at present existing there are frequent stoppages in the production of gas due to the opening of the *bell* to admit the charges of ore and fuel, and at other times when the molten metal is being run from the furnace. In our issue of September 15th last, we drew attention to this, and the provision of a gas holder to store sufficient gas to carry over such periods. The figures showed that the capital cost of such a holder was not so high as might have been expected, while the advantages of such a governor were clearly defined.

To quote from Mr. Freyn:—"A blast furnace plant of only two 400-ton furnaces should be equipped in the beginning with a power station of only limited capacity corresponding to the available power from *only one furnace*, installing later on additional units, if the conditions and operations of the furnace plant are such as to safely permit the generation of additional electrical power." This standby factor of ·5 could be considerably reduced if there were three furnaces in place of two, as then it would be sufficient to only keep one-third of the plant as standby.

Mr. Freyn then calculates on the assumption that an electrical power plant of about 10,000 B.H.P. is installed at first. Selecting units of 1,500 B.H.P., seven gas engines would be equivalent to 10,500 B.H.P., with an eighth engine as standby, and for these, electrical generators of 800 KW. would be furnished, which would, according to Mr. Freyn, perfectly fulfil the requirements, as they easily stand an overload of 25 per cent. for 24 hours, and an overload of 40 per cent. for short periods.

Calculating on double-acting gas engines direct coupled to 800 KW. three-phase 25-cycle 6,600-volt alternators, the total cost of the station is given at £154,375. Of this £6,979 is chargeable to the gas cleaning plant; buildings, £9,375; and gas engines, £88,333; the complete electrical equipment would cost £33,854. The cost of the installation calculated on an output of 3,800 KW. is equivalent to £18·64 per KW.

However, this is without providing any gas holder, and if it was necessary to include a gas holder of sufficient capacity to keep the engines running during one hour's total cessation of gas production, the total cost would be increased by about £7,000, making the total £161,375, or £19·49 per KW.

Mr. Freyn goes on to estimate the operating cost as follows, to which we have added the cost of a gas holder:—

Operating Cost of Power Plant.

	Without gas holder.			Including gas holder.		
Load	Full	¾	½	Full	¾	½
Fixed charges ..	·07875d.	·1038d.	·11855d.	·08229d.	·10847d.	·12389d.
Water	·01437d.	·01757d.	·02118d.	·01437d.	·01757d.	·02118d.
Lubrication ..	·0123d.	·01461d.	·02109d.	·0123d.	·01461d.	·02109d.
Repairs	·01434d.	·01681d.	·02416d.	·01498d.	·01756d.	·02524d.
Staff	·02783d.	·03477d.	·05501d.	·02783d.	·03477d.	·05501d.
Fuel value* ..	·0724d.	·08145d.	·0972d.	·0724d.	·08145d.	·0972d.

* To arrive at a value for the fuel comparison made with coal and natural gas, gave ½d. per 1,000 cb. ft.

Mr. Freyn concludes by giving some particulars of the figures actually obtained at the John Cockerill Co.'s Works, Seraing.

This company has a large installation for electric power development, chiefly driven by gas engines working on blast furnace gas, the total rating last year being 3,700 KW. While the cost per KW.-hour in 1900 was 0·83d., in 1905 this had fallen to 0·206d., the reduction being almost entirely due to the utilisation of blast furnace gas in gas engines.

Notes on the Construction and Maintenance of Overhead Equipment.

By R. N. Tweedy and H. Dudgeon.

In the discussion on this paper, which was read before the Institution of Electrical Engineers at Birmingham on February 14th (see Electrical Review, March 9th), Mr. Henry M. Sayers (London) wrote sympathising with the authors in their attack on needless expenditure in overhead construction. He suggested that every specification for overhead work should provide that no two metals, galvanically different should be in contact, as he was convinced that this was right in principle. Iron or steel bolts deteriorated very badly just above the ears, as observed by the authors. He found it hard to understand the authors' statements as regarded the difficulties experienced with bronze bolts. It did not seem that the somewhat more rapid oxidation of the deposited iron could come into play, since, so long as the line was alive, it would be negative to the electrolyte and much mingled with hydrogen. If shellac and other organic messes were discarded and hanger bolts insulated with porcelain reels, strung in the span wire as suggested, the most serious trouble with overhead work would disappear. The invention of the splash guard seemed a brilliant notion, but accumulation of dust and spiders' webs above the shield would need attention. He did not agree with the advocacy of slack wiring; it was mechanically wrong. But overhead work might be overstrained, especially when put up in the summer. He suggested that what was wanted in an ideal trolley wire was uniform vertical rigidity, and any departure from uniformity must result in local wear.

Mr. H. E. Yerbury (Sheffield) wrote that the poles in any section should be kept as nearly as possible of one diameter, the thickness being varied according to the strains. He believed that to dispense with the base would shorten the life of the pole. In Sheffield they painted the poles once a year, and raised all bases and collars, which was a simple matter when only a thin film of mastic cement was used at the joint. In some parts of their system the atmospheric conditions were very bad, and they found it economical to use phosphor bronze or copper span and guard wires, as galvanised material did not last longer than about three years. They had discarded ordinary hanger bolts, as the rust split the insulating material, and used either galvanised or sherardised insulated bolts, which lasted several years longer. In his opinion, porcelain reels were entirely satisfactory on pole straps or flexible suspensions. He approved of deep grooved ears, unsweated. In Sheffield they had discarded soldered ears for about five years with gratifying results. "Figure 8" wire was desirable where wall rosettes were used, as it was less noisy than ordinary wire. He was surprised that no mention had been made of either phosphor bronze or "Phono" trolley wire. They had had both materials in use about four years, with good results.

Mr. Henry Mozley (Burnley) wrote, saying that he had long been dissatisfied with the extravagance in construction visible on all hands, and improvements in this direction would enable many a branch line to be opened, on which at present there was no prospect of meeting capital charges.

Mr. Henry Lea said that from an æsthetic point of view it was not desirable either to lighten the poles or do away with the bases and collars. In the Lorain system in use at Wolverhampton there was a remarkable freedom from breakdown, and the system did not suffer from the many troubles referred to by the authors in connection with the overhead system.

Mr. C. W. Hill said it was suggested that guard wire might not be at the same potential as the wires they were supposed to protect, since the latter might be connected with earth in a certain position near the rails, where the potential was higher or lower than at the point where the guard wire was bonded to the rails. This effect was likely to give false instrument readings, and might be the cause of accidents. With regard to the Standard Committee's poles, he had found from actual load tests within the specified limits that all the deflection took place in the bottom section. The strength of poles for span wire work must be determined by the size of the trolley wire, the weight of proposed fittings and the required span. The detrimental effects on the life of the poles due to bases, could be overcome by a liberal use of Dr. Angus Smith's compound, by coning the concrete at the ground level, and by properly caulking round the top of the base. He had found gun-metal fittings perfectly satisfactory where properly galvanised span wires were used, and believed the grooved circular trolley wire would prove more satisfactory than the "figure-8" section, provided well-designed ears were used. As far as the size was concerned, the use of heavier gauges than formerly was due to the inability of the small sizes to stand the wear and tear of heavy city lines. His experience showed that the greater the rigidity of the suspension, the greater the wear due to increased arcing and hammering.

Mr. R. F. Brown said that within the last two years he had erected and tested several types of pole similar to those referred to in the paper. A pole 31 ft. long 7⅜ in. × ·4 in., 6⅜ in. × ·31 in., and 5⅜ in. × ·26 in., weighing 840 lb., was, he believed, the second pole mentioned. Tested in the usual manner, these poles gave 5⅝ in. temporary deflection with a 500 lb. pull, and ¼ in. permanent deflection with 1,000 lb. A taper pole 31 ft. long 6½ in. × ·437 in. to 4½ in. × ·437 in. weighing 865 lb. deflected 3⅜ in. with 500 lb., and showed a permanent set of $\frac{3}{16}$ in. with 1,000 lb. The Standards Committee's medium pole, 8⅜ in. × ·343 in., 7½ in. × ·31 in., and 6½ in. × ·25 in., weighed 875 lb. The temporary deflection with 1,250 lb. was 5⅜ in., and with 1,750 lb. the permanent deflection was ¾ in. Although the weights of these poles only varied slightly, there was a good deal of difference in the strength. In comparing weights it must be remembered that a three-joint pole might easily weigh 72 lb. more than a corresponding taper pole, owing to the telescopic joints. The cost of taper poles was considerably more than three-joint poles of similar strength. The suggestion that 2 in. rake was enough for a pole before any strain was put on depended entirely upon the strength of the pole. He agreed with the authors' remarks about concrete, and suggested that there were many poles in this country standing up to their work, which had been erected with practically no cement in the concrete. He could see no reason why poles could not by erected with lime concrete, in maiden ground, except possibly anchor and pull-off poles. He believed in pot reel insulators, and had had some of the same type as those mentioned tested, which broke with a strain of 2,200 lb. He now used a larger size which, he had no doubt, would

not fail under 2 tons. A great point in favour of these insulators was that if they failed electrically, they had already failed mechanically, and this failure could be seen from the road without difficulty. They were also more easily replaced than other types, and required no re-nozzling. He favoured "figure-8" section wire.

Mr. P. J. Pringle (Burton-on-Trent) in a written communication, agreed with the authors as to the cause of the deterioration of hanger bolts. He believed that the shield introduced by the authors would remove the cause of the trouble, and he was having these fitted in all extensions and renewals. He could not agree with the recent contributor to the Electrical Review, who contended, in opposition to Mr. Tweedy, that the wear on ears and trolley wires was mainly mechanical, and not due to arcing, neither was the type of ear illustrated any improvement. On a hill with a maximum gradient of 1 in 11½, he had had to replace some of the ears on the up line, which were of the ordinary deep groove pattern with 000 circular wire, in about 1½ to 2 years. He found the wear on the up-line trolley wire in the vertical plane 5 to 6 mils more than on the down line. The side wear on the trolley wire towards the end of the ears, owing to the rapid wearing away of the ear (no doubt principally due to arcing) was in some cases as much as 25 mils. The greatly reduced conductivity of the ear compared with the trolley wire, coupled with the reduced contact surface between the wheel and the ordinary ear, caused the pitting appearing on ears which was very marked on up grades, the trolley wire on the same line showing no such appearance.

Mr. H. R. Prosser said that the South Staffordshire poles were strong enough to carry all necessary strains, but were far too resilient when the cars were passing, and this caused hammering and sparking. Bases protected the most important part of a pole—viz., that at the ground line—where all destruction commenced, and continued more rapidly than at any other part of the pole. He did not believe in the arrangement of soldering a piece of "figure-8" section wire to the top of the trolley wire and to the underside of a clip, when a proper mechanical clip would do away with all the difficulties spoken of. Owing to oscillation, trolley wheels did not wear to the radius of the wire, but to a larger radius, and so were able to accommodate their travel along the clips.

Mr. H. Hartley agreed with the authors that in many instances poles and bases could be reduced in weight and cost without sacrificing safety or durability. The South Staffordshire poles had been instanced as light poles. The larger size, 7 in. × 3¾ in. × ¼ in., had in some cases bracket arms 10 to 11 ft. long carrying two wires. They had been in service 13 years, and were still in excellent condition, except for a little corrosion on the ground line. Bases did protect the poles, and it would be a mistake to dispense with them. The old South Staffordshire poles had no bases, but simply a small collar at the ground line; they showed undoubted signs of corrosion, but on one side only (the footpath side). His experience bore out that of the authors as to the local action which took place between gun-metal and the galvanised span wire. Malleable fittings were generally machined after being galvanised, and it was at the junction of the machined portion and the galvanising that it commenced to peel off. The best insulator he knew of was the bell-shaped, with the bolt moulded into the insulating material. He knew of some in service now that had been in use since 1892. Porcelain was the best material for secondary insulation, and he saw no reason why it should not be used for primary insulation. He considered the mechanical type of ear the best. Hammering action was most marked on solid construction or short bow strings. "Figure-8" wire had given smooth running and no wear on the ears. The trolley-wire on the old South Staffordshire system was originally ·34 in. diameter, and the maximum reduction due to wear that he had been able to trace was ·015 in., except at the ear. He did not think that the new soldered type of ear would suspend the wire efficiently.

Mr. C. W. Fourniss said he agreed that for ordinary work a saving could be effected in the weight of poles. The rake of a pole depended on the nature of the ground. For all practical purposes bases were unnecessary, but in his dealings with local authorities he had always found a decided objection to such a suggestion. Pillars filled with bitumen gave no trouble, but when finished off with concrete they were a continual source of trouble, water collecting in nearly every box on the route. For secondary insulation they had discontinued the use of Brooklyn and globe strains, as they found porcelain insulators quite suitable. He agreed that 00 wire was sufficient for a line with a five-minute service, but with a more frequent service a larger wire was absolutely necessary. Poor or hard metal in the trolley wheels soon caused appreciable wear. His experience had been that rolling friction had a great deal to do with depreciation, and also that the method of suspension did affect the wear to a very great degree. He had discovered that the wire wore taper from ear to ear, getting smaller in the direction of running, the wear at the centre of the span being approximately a mean between the wear at either end. Wear on central under-running work was much less than on side-bracket work.

Mr. Mercer said that in many towns the poles were much too heavy. The standard poles were quite light enough, and should be strengthened at the bottom section to stand up to the evils resulting from sweating. He had never yet planted a span pole with only 2 in. rake except in rock, and in other cases never less than 4 in. to 6 in. according to the soil, the result being that the span wire was pulled up taut, and gave about 12 in. sag with the weight of the trolley wire on it. Bases should be shorter and lighter than those generally used, and certainly should be ventilated. All guard wires should be thoroughly connected to the rails every 200 yards. The idea of inserting a shield between the trolley wire and the hanger seemed excellent.

In his reply, Mr. R. N. Tweedy paid a tribute to the important share which Mr. Dudgeon had taken in the preparation of the paper. It was he who had discovered that the deterioration of hanger bolts and secondary insulators was due to electrolysis, and it was he who had followed through to logical conclusions the whole subject of the wear of trolley wire and ears. With regard to Mr. Sayers's important communication, he had to admit that gentleman's vastly superior knowledge of such a difficult subject as electrolysis, but a careful study of all the circumstances left little room for doubt in the minds of the authors that bronze bolts were actually more prone to failure than iron bolts. He thought that trolley wire ought to be as tight as was consistent with its ultimate strength, and that span-wire ought to be much slacker than it was. In reply to Mr. Hill, the authors' case for lighter poles was that the sizes of existing poles had been forced on them by the general acceptance of a false standard of rake, while the size of the trolley wire had increased beyond the real necessities of the situation. The authors declared that, given proper ears which did not obstruct the passage of trolley wheels by coming into contact with them under any circumstances, and given a wire no larger than 00 S.W.G., but rolled with a specially large radius for the under side; then the heaviest city service would not depreciate that wire to anything like the extent that the largest wires now used were depreciated, under the generally defective methods of suspension in use. The authors contended that 0 S.W.G. circular wire had proved itself strong enough for safety over 10 years' service under bad conditions, and that no harm would follow the use of 00 S.W.G. wire even though its ultimate strength was no greater than 0 S.W.G. Mr. Yerbury expressed surprise that the new phosphor bronze trolley wires were not used more; but the extra strength they gave was not required, while the resistance was very much higher than that of hard-drawn copper. When the authors spoke of the serious wear due to arcing, they did not refer so much to the arc struck sometimes between the trolley wheel and the end of an ear at the moment of impact or at the moment of leaving, as to the arcing (not visible to an observer unless on a level with the wire), which was due to the excessive current density at the actual contacts either when the car was taking heavy currents from a small section wire, or when the section of the path presented to the trolley wheel was enlarged and the contact accordingly diminished when an ear of the ordinary type was encountered.

If taper poles could be made so that the thickness of the metal decreased with the height, sectional poles would not be used, and ideal conditions of maximum strength for minimum weight would obtain. The flexibility of the South Staffordshire poles must tend to decrease the hammering and sparking which Mr. Prosser had noticed, and those evils were due solely to the particularly bad type of ear used on those lines. The new form of ear exhibited had been in service for several months with entire success, and further trials were to be made. The figure-8 portion was soldered to nothing but the wire. Mr. Hartley's opinion that the signs of corrosion on the footpath side were due to the attentions of dogs, was borne out from other quarters, and that trouble might be overcome by simpler means than those adopted now. The recommendation to fix reel insulation horizontally, instead of vertically, as usual, was based on experience, but referred more to flexible suspensions than to spans. The reel in that position was able to withstand the shock of a de-wired pole hitting the suspension wire much better than if it were vertical, and the strain had to be taken by the flanges. All circular wire, but especially 0 S.W.G., wore quickly to a flattened running surface in order to provide the necessary area in contact with the trolley for the current delivered at any point.

Physical Society.

At the meeting on March 9th, 1906, Dr. C. Chree, Vice-President, in the chair, Prof. H. A. Wilson read a paper on "The Velocities of the Ions of Alkali Salt Vapours at High Temperatures."

Dr. J. A. Harker read a paper "On Some Experiments on Earth Currents at Kew Observatory." Dr. Harker gave an account of experiments made some years ago at Kew Observatory on the earth currents produced by electric traction schemes, and on the disturbances they caused on the self-recording magnetic instruments which were kept continuously running there to register the variations in the declination and the horizontal and vertical forces. For these experiments two large earth-plates were buried in the ground about 4 ft. deep and 200 yd. apart. These were connected through a photographic recording voltmeter of high resistance. On the traces given by this instrument the effect of the trains on the Central London Railway was strikingly shown, and specimen records exhibited clearly indicated the time-table of that railway and also any accidental breakdowns. The nearest point to Kew, namely, Shepherd's Bush, is about 6 miles distant. The same disturbances, and also those due to special traction experiments carried out on the system of the London United Electric Tramway Co. during the period when the Central London Railway was shut down, were clearly shown on magnetograph curves. The effects are much greater on the vertical force than on the horizontal force or the declination, the latter being only slightly affected. A second system of investigation was to connect the earth-plates through the primary of a transformer, the secondary terminals of which were connected to a sensitive moving-coil galvanometer of suitable period and damping. Under these conditions the galvanometer recorded a ballistic throw for each movement of a tramway controller, while the slower variations due to magnetic storms and other causes were without effect. A telephone similarly connected gave a perceptible sound for each controller movement.

Dr. Chree remarked that the state of affairs at the present time was very much worse, and the vertical force records were so disturbed as to be useless. The author's curves showed that there was a quiet time at night, and Dr. Chree suggested this time for the determination of the absolute values of the magnetic elements.

The Maintenance of Underground Mains.

In the course of the discussion which followed Mr. G. L. Black's paper (Electrical Review, January 19th), Prof. Andrew Jamieson said that the faults which had been experienced in tropical climates were not such as were found in a network like that in Glasgow. Murray's test he described as the most accurate yet devised; a fault in 2,300 nautical miles of cable between Aden and Bombay had been spotted within 2 miles by its aid.

Other speakers took part in the discussion, which was afterwards adjourned, and resumed on the 13th ult.

Mr. F. A. Newington (Edinburgh) thought that the mains question might be settled, as at Glasgow, by combining the draw-in system with the solid system. He was surprised that they drew high-tension mains into earthenware ducts laid in concrete, because these mains, as they would never require branches to be taken off them, were practically adapted to be laid in solid. He criticised the use of pitch instead of bitumen for filling in troughing, and maintained that it was easy to locate faults with a linked-up system. The method of fault finding described in Mr. Black's paper (fig. 1) seemed rather dangerous, because directly the switch was opened the negative wire would be at earth potential, the middle 250 volts above earth potential, and the positive 500 volts above earth potential. That would be rather trying to the wiring in the consumers' houses. After a fault had been located in a length of distributor, the author did not say how it was to be found. A loop test would not be of much use where there was a lot of branches taken into consumers' houses. In his opinion it was a case of using pick and shovel. They had a good deal of copper strip in Edinburgh, and it gave them less trouble than any other system. The difficulty of the pull on the strip was got over by the use of porcelain blocks placed underneath the copper strip. They also used ventilated box covers, and found in them a great advantage. The system of triple-concentric distributors seemed complicated, awkward for the connection of new consumers, more costly to install, and more costly to maintain. Therefore he thought the draw-in system was to be preferred.

Mr. J. A. Robertson (Greenock) thought that a system of single cables was much better. He preferred bitumen and earthenware troughing to wood troughing and pitch, the difference in cost being small. Cable laid in this manner had given absolutely no trouble. The best system of main laying was to draw in the feeders and lay the distributors solid. Paper-insulated bitumen-sheathed cable was the best that had yet been put on the market.

Mr. H. B. Maxwell (Partick) believed in pitch and in triple-concentric cables; if a fault occurred there was no difficulty in finding it. Cast-iron troughing suffered from shortness of life.

Mr. W. W. Lackie (Glasgow) said that in Glasgow they had 80 feeders each with eight distributors; if a feeder failed, with their present method of connecting up, only 1/80 of the city would be affected, and if a distributor went wrong, only 1/640 would be affected. The B. of T. preferred each feeder to supply its own area, the distributors between the areas being connected through fuses. In Glasgow they had abolished the fuses connecting the areas, and put fuses in each distributor. A considerable fall in cost of repairs had taken place since splitting the networks in this way. In Glasgow they had 20 feeders running from Port Dundas station, each of which required about 6 in. of space, and to lay them on the solid so that access could be had to them all would require 10 ft. of the roadway. The late Mr. Foulis, chief engineer to the Glasgow Corporation Gas Department, had found that pitch was in quite good condition after 50 years' use, although exposed to all sorts of weather and temperature. Wood troughing obviated the troubles which they had experienced with earthenware ducts shifting through vibration and the passage of heavy traffic over them.

Mr. C. A. Parsons said that wood troughing came out at 2s. 7½d. per yard; Howard conduit, 3s. 5½d. per yard; earthenware troughing, 4s. 5½d. per yard. For the latter the cost of labour was 2s. per yard, compared with 1s. 4d. for wood and 1s. 2d. for Howard conduit.

Mr. Ternie (Edinburgh) said that in three-wire low-tension systems, if the third wire were insulated and the negative earthed, there would be very few faults except those due to mechanical injury or stray tramway currents.

The Chairman (Mr. J. M. M. Munro), in closing the discussion, said that he had found no disadvantage arising from the use of pitch. Great credit was due to Mr. T. O. Callender for so early discovering the advantage of vulcanised sheathing for underground cables.

Mr. Black, in reply, said that Mr. Abraham was correct in saying that high resistance faults on the positive and negative mains simultaneously would not be indicated by the ammeter between the middle wire and earth. Those, however, did not seriously interfere with the readings, and would likely be broken down in making the test described in fig. 2. The flashing of the middle wire to earth might be done through a resistance, to obviate any serious disturbance to the supply. A fault could be roughly located by flashing and watching the fixed ammeters, even though the network and feeders were all interconnected outside. The oil used with the pitch was bought as asphalt oil. In dry weather 8 gallons, and in wet weather 10 gallons, were used with each ton of pitch. There were in use in Glasgow 4·85 miles of old mains laid before the use of triple concentric, of which slightly over a mile was rubber cable. The total amount of rubber cable laid was about 10 miles. The latter portion of the paper described the tests used in finding faults when the bad sections had been located. No difficulty had been found in using those tests even on sections having many consumers' branches attached. He had not had the opportunity of trying those tests on the extra high-tension mains, as the diatrine cables had given absolutely no trouble.

THE NEUTRAL MARKETS OF THE WORLD: THEIR OPPORTUNITIES.

II.—Brazil.

From a geographical point of view, if from no other, Brazil offers great opportunities for the extension of electrical enterprise, being amply supplied as it is with water-power suitable for electrical purposes. The population is estimated at about 20,000,000, distributed over an area of 3,216,166 square miles. The imports are slowly but steadily increasing; in 1904 they amounted to about £26,000,000, as against £25,000,000 in 1903 and £22,000,000 in 1902. The exports amounted to £39,000,000 in 1904, as against £36,500.000 in 1903 and £40,000,000 in 1902. A distinct improvement in the commercial conditions of Brazil has recently been shown, and it is stated that a further improvement may yet be expected. The causes of this improvement may be traced to, among other things, the increased confidence in the Republic which is being shown abroad, the extension of public works, and the improvement in the exchange, which, after standing at 12d. for some years, has now risen to more than 16d.

As regards the importation of electrical goods into Brazil, it will be found on reference to the trade statistics, which are, by the way, rather belated, that in 1903 there was an increase on the whole, with decreases in certain classes. The importation of cars for railway purposes increased from 571,530 milreis in 1902 to 649,065 milreis in 1903; the imports from Germany and the United Kingdom greatly decreased, whilst an increase was shown in the imports from the United States. The imports of copper wire, plain or covered with any material, decreased from 814,081 milreis in 1902 to 411,198 milreis in 1903; large decreases were evidenced in the imports from Germany and the United States, whilst an increase of nearly 20,000 milreis was shown in the imports from the United Kingdom. The imports of insulators decreased from 107,598 milreis in 1902 to 61,382 in 1903, and in this class also the imports from Germany and the United States decreased, whilst those from the United Kingdom increased; nevertheless the imports from Germany were slightly in excess of those from the United Kingdom. The imports of appliances for electricity, electric lighting, &c., not otherwise specified, increased from 2,240,619 milreis in 1902 to 2,503,924 milreis in 1903; the imports from the United States were 1,616,043 milreis in 1903, as against 394,704 milreis from the United Kingdom, and 327,726 milreis from Germany. Motors, fixed engines and parts thereof were imported to a value of 529,364 milreis as compared with 588,154 milreis in 1902; the imports from the United States increased, whilst those from the United Kingdom and Germany showed decreases. The imports of machinery and apparatus not separately specified amounted to 9,714,957 milreis as against 8,976,001 milreis in 1902; the imports from the United Kingdom were 4,626,265 milreis, but showed a slight decrease; the imports from the United States and Germany, although in each case only about half the value of the imports from the United Kingdom, showed increases. The above values are in paper milreis. The average exchange for the paper milreis in 1903 was about 12d. The total imports from the United Kingdom to Brazil amounted in value to 60,988,902 milreis; from the United States, 24,283,801 milreis; and from Germany 26,506,366 milreis; there were increases in the cases of Germany and the United States, but a decrease in the case of the United Kingdom. The values for these total imports are in gold milreis (gold milreis = 2s. 3d.)

It will be seen from these figures that to a certain extent the United Kingdom is holding her own on the Brazilian market, but that in one of the largest items, viz., appliances for electricity, &c., the imports from the United States far exceed those from the United Kingdom and Germany together. There is no doubt that the investment of capital in Brazilian undertakings has led to much of the trade, and it is a generally accepted fact that investment of capital, not necessarily in electrical undertakings only, has had, and will continue to have, a great effect on the trade of the country, with special reference to the countries from which the goods are imported. The special commissioner appointed by the United States Government recently, to inquire into the trade conditions of Brazil, has advised his countrymen to invest in up-to-date enterprises with a view to establishing a greater purchasing power in the country, and hence a market for American goods. Germany and the United States have not been slow in this respect. The German Consul at Curityba recently reported that the electrical works in that town, and in other towns in the district, were entirely of German origin, and that the market for German goods was rapidly extending. Moreover, the Allgemeine Siemens-Schuckert Co., have recently established a subsidiary company in Rio de Janeiro to undertake the sale of their goods, and to take up concessions, &c.

The most important American undertakings of recent years have been the Rio de Janeiro Tramway, Light and Power

Co., incorporated in Canada in 1904, and backed by Canadian and American capital, and the Sao Paulo Tramway, Light and Power Co., which began operations in Sao Paulo some five years ago. The former company has taken over several lines of tramways in Rio, some of which were financed by German capitalists, as well as the gas company which belonged to Belgian capitalists, and recent advices from the United States report that the Rio de Janeiro Tramway, Light and Power Co. has placed contracts in that country for the initial equipment of the 100,000-H.P. hydro-electric plant to be built about 85 miles from Rio. This is stated to be the most important order ever given in the United States for electric equipment for South America.

In this respect it may be noticed as interesting, that when the Para tramways were taken over by an English company some time ago, the American Consul reported to his Government on the matter, and stated that he had good reason for believing that the necessary material would be procured in the United States. It would be interesting to know what effect recent developments in electrical enterprise in Brazil have had upon the import figures, particularly as regards the countries of origin, but, unfortunately, details of any value are not yet available. It may, however, be presumed that investment of German and American capital in these and other enterprises has had, and will continue to have, a considerable effect on the imports of electrical and other materials from these countries. There are still innumerable openings for enterprise, but, unfortunately, Brazil has a poor reputation, which may or may not be wholly undeserved. The British Consul-General at Rio states that the advantages of electricity for lighting and power purposes are fully appreciated in the country, and encouraged by a helpful system of natural watercourses, installations have been made in several of the smaller towns. As a competitor of electricity, alcohol is engaging much attention for illuminating and industrial purposes. The following list of engineering requirements in Brazil, which is recommended to the consideration of British firms, was formulated by the British Consul at Rio, who states that there is a field for enterprise in all the branches specified: (1) Electrical works; (2) hydraulic machinery, turbines, Pelton wheels, &c., especially as applied to electrical transmission—Brazil offers special facilities for this class of work; (3) locomotive engineering; (4) railway carriage building; (5) mining engineering; (6) milling and grinding machinery; (7) cranes and other lifting machines.

The great centres of trade are Rio de Janeiro and Sao Paulo, and it is in these States that the greatest developments may be looked for. A great future is also predicted for the Amazon Valley, but it is not anticipated that any very great opportunities will present themselves for some years to come.

The following are the duties leviable on various kinds of electric material imported into Brazil: Insulators, buttons for electric bells and porcelain wares of various kinds, with or without copper, for electric installations, 200 reis per kilog.; glass insulators, 100 reis per kilog.; copper wire, plain, 400 reis per kilog; copper wire, covered, 900 reis per kilog; copper wire, with an envelope of lead or iron for submarine or underground cables, power, light, or other electrical purposes, 20 per cent. *ad valorem;* articles of copper not otherwise enumerated, 2,000 reis per kilog.; telegraph and telephone posts of iron, 20 per cent. *ad valorem;* carriages, &c., for railways, &c., 30 per cent. *ad valorem;* dynamos and other electric apparatus for the distribution of power and light, locomotives and tenders, traction engines, hydraulic motors, turbines and hydraulic wheels, windmills and other motors, 15 per cent. *ad valorem;* electric machinery of various kinds for milling, pressing, &c., 15 per cent. *ad valorem.* On the majority of goods imported it has been decreed that 35 per cent. of the duty shall be payable in gold so long as exchange remains above 15d. The present rate of exchange is $16\frac{9}{32}$d., and the gold milreis is equivalent to 2s. 3d., so that at the present time 35 per cent. is payable at the rate of 1 milreis = 2s. 3d., and 65 per cent. at the rate of 1 milreis = 1s. $4\frac{9}{32}$d. In the case of goods imported *viâ* Rio de Janeiro and Rio Grande do Sul a surtax of 2 per cent. gold is levied for the purpose of defraying expenses in connection with port works which are being carried out.

The following are the leading importers of electrical goods in the chief towns:—

Rio de Janeiro.—Itmaos Braconnot r. Quitanda, 40; Brazilianische Elektrizitäts Gesellschaft, Praca Tiradentes, 45; Casa Cresta, r. Quitanda, 41; F. G. Braga, r. Goncalves Dias, 46; Companhia Telephonica, Praca Tiradentes, 45; Fred Figner, r. Ouvidor, 105; Guinle & Co., r. Ouvidor, 64 B; H. Smyth, r. Rosario, 115; Haupt, Biehn & Co., r. Alfandega, 42; Compagnie de Travaux et d'enterprises au Brazil, r. Primejro de Marco, 79.

Fortaleza (Ceara).—Antonio Henrique da Justa, r. do Senador Pompeu, 92.

Sao Paulo.—Guinle & Co., r. Direita, 7; Joao Riva, r. Gen. Osorio, 141; Laur Habasinski, largo do Ouvidor, 3.

Influences operating against trade development, says the Rio Consul, are to be found in the heavy taxation and in the commercial laws which make the recovery of debt uncertain, thus facilitating inequitable and secret settlements between unscrupulous traders, to the detriment of less favoured creditors, and particularly of such as are not resident, or are not adequately represented, in the country. In consideration of these facts it has been considered advisable to warn manufacturers and merchants against opening up direct trade with Brazilian firms except with fully approved guarantee. They are advised to do their business whenever possible through the merchant commission firms, many of whom have buying agents in London. Such arrangements need not, and should not, however, deter those wishing to open up trade from going out to ascertain the requirements of the market, and the Consul is of opinion that the time is now opportune for such a visit. Reform is necessary in the compilation of catalogues, especially in those issued by engineering firms. Many expensive works are sent out which fail to attract business, chiefly because they are exclusively in English. They should be in Portuguese, the language of the country, with the metric system of weights and measures, and should be distributed as widely as possible, not only in the coast towns, but also in the interior, where there are many industrial enterprises of considerable importance. The mere sending of catalogues, however, is said to be utterly useless, except in the case of old-established firms whose manufactures are well known on the market. Commercial travellers should be linguists, for with the gradual developments of the last few years, the import trade is now more and more in the hands of Portuguese and German houses. French has taken the place of English with Brazilians proper as an alternative language to Portuguese. Technical experts are the best agents, and German exporters have grasped this fact, with the result that, although as a rule high salaries are paid to their agents, the business which accrues shows that the money is not wasted. The rates of tax payable by commercial travellers vary in the different States of Brazil from 200 milreis to 1,000 milreis. Commercial travellers have to pay import duty on samples they bring with them; in cases, however, where such duties do not exceed 1 milreis per package, no charge is made, and in cases where charge is made, the amount is supposed to be refunded on exportation.

Information as to Government calls for tenders is published in the various official and commercial newspapers, but the time given is usually very short. Moreover, it is often stipulated that further information will only be given on personal application. So that for these reasons alone, it is necessary that firms desiring to take up Government contracts should be well represented on the spot.

In conclusion, it will not be out of place to quote from the report of the Special Commissioner sent by the United States Government to inquire into the trade conditions of Brazil. With special reference to electrical opportunities in Brazil, the Commissioner writes:—"Brazil has an enormous amount of hardwood fuel, and is supplied as few countries are with water-power which is being made available by electric transmission. The entire eastern tier of States along the coast consist of a narrow belt of low coastal plain backed by a mountainous plateau, ranging in elevation from 2,000 to 7,000 ft. Rainfall throughout nearly all of this section is abundant, rivers are numerous and swift, with a steady flow of water and many falls, and the distances necessary for transmission to possible industrial centres are generally small; there is no reason why the same development should not be made in the utilisation of this power as is now being made in Italy, Switzerland, Mexico and other countries. . . . . The opportunities are abundant. Harbour and dock works, city improvements, paving, road making, the development of electrical power and lighting, telegraph and telephone services, street railways, railroads and many similar enterprises are beginning to be a prominent feature in the development of the new Brazil."

ELECTRIC RAILWAYS IN GERMANY.

The Question of State Ownership.

It is now possible to state with some degree of certainty that there is very little, if any, prospect of private enterprise in Germany being permitted to construct and work electric railways on important lines of communication, and this may be said to settle once and for all any schemes which companies may advance on their own account. The States, whether Prussia, Bavaria or Saxony, are committed to the principle of State ownership, and they are not prepared to recede from this position in favour of any company. This, then, is the principal explanation for the slow progress of electric railways in Germany; but there is hope that the electrical engineering firms will find in the State a large customer in the future on its own account, as it is expected that the Government will proceed gradually with the introduction of electric traction on the railways.

The experimental work on the Berlin suburban railway section between Nieder Schoneweide, Johannisthal and Spindlersfeld, is about to be suspended, if it has not already been discontinued for the present. As will be remembered, the trials have been made with motor-cars on the single-phase alternating-current system for the purpose of gaining experience in respect of the transformation to electric traction of city and suburban lines. The last few months have been occupied in the testing of the new motor-cars built by the Allgemeine Co., which are to serve as the basis for the cars to be introduced on the Hamburg-Altone Railway. A report on the results of the trials is now in preparation for presentation to the Minister of Public Works (Railways).

Berlin Underground Railway Extension.—The Elevated Electric Railway Co., which already has several miles of line in operation of both the high level and underground type, now proposes to expend £2,750,000 in extending the railway from the Spittelmarkt to the Alexander Platz and the circle railway station at Schonhauserallee. The prolongation will be a continuation of the existing shallow underground tunnel, and the railway will be carried under the Spree on its way to the Alexander Platz. As the authorised section between the Potsdamer Platz and the Spittelmarkt is to be completed in 1907, it is expected that the extension to the Alexander Platz will be finished before the end of 1912, and

that to the Schonhauserallee, where the line will be brought to the surface and raised to an elevated position, as is the case already at the Nollendorf Platz, will be brought into use in 1915. According to the scheme which has been provisionally approved by the city authorities, the extension provides for the establishment of 12 stations, and as far as possible the tunnel construction will be carried out by the opening up of the streets which in some cases will be entirely stopped to vehicular traffic. The concession for the extension is to lapse in 1987, or the same time as when the concession for the existing line will expire, and at the end the railway will become the property of the city without any payment. During the operation of the agreement the company undertakes to pay to the city every year 2 per cent. of the gross receipts when these amount up to £50,000 per kilometre of route, 2¼ per cent. when the gross receipts range from £50,000 to £75,000 per kilometre of route and so forth on a rising scale. In addition to this the city will participate in the net revenue to the extent of one half of the surplus remaining after the invested capital has received 6 per cent.

The Langen Suspended Railway System.—The question of establishing a suspended electric railway on the Langen system in Berlin, which was first brought under the notice of the municipal authorities three years ago, has now advanced a further stage which may possibly have the effect of bringing the scheme to a successful issue. At present, the promoters of the undertaking—the Continentale Gesellschaft fur Elektrische Unternehmungen, of Nuremberg—have an entirely new project in view, or at all events, it differs materially from that which was originally brought forward. The proposal contemplates the construction of an elevated railway commencing at the Gesundbrunnen railway station in the north, proceeding to the Alexander Platz and terminating at Rixdorf in the south, the total distance being 7½ miles. It is intended to build 15 stations, and the average speed would be higher than that prevailing on the existing underground electric railway. The promoters ask for a concession for 90 years, at the expiration of which the railway would pass into the possession of the city authorities in so far as it existed on public streets, while the plant, rolling stock, &c., on the company's property would remain in the hands of the company, although the city could purchase at a valuation plus 10 per cent. Provision is also made for municipal expropriation at the end of the first 30 years and at each succeeding period of 10 years, on the basis of the principles settled in the case of the Elevated Electric Railway. The promoters undertake to give the municipal authorities, for the use of the streets, a share in the net profits in so far as the dividend on the invested capital exceeds 6 per cent.

The principal stumbling block in the way of the erection of a suspended railway has hitherto been the insistence of the city authorities upon the establishment of a short experimental line in Berlin before giving any decision in the matter. Yet all the members of the Highways Committee have personally inspected the Barmen-Elberfeld line, and probably the other City Councillors are also familiar with its method of construction. But as they are determined to see how the suspended system actually appears in Berlin, the Continental Co. has now decided, as reported at the end of February, to erect a trial section for the purpose, probably in the Zeughof Strasse. It is understood that the Minister of Public Works has approved in principle the scheme for the construction of the projected suspended electric railway.

A Municipal Scheme.—After consideration extending over a long period, the Berlin City Council has at last voted the sum of £1,500 for the preparation of a special scheme for a municipal electric railway of the shallow underground type between the north and the south of the city, and in passing the vote the Council expressed the opinion that the construction and working of the railway should be undertaken by the city. The line, which is to have a total length of 5½ miles in Berlin, is to extend from Kreuzberg in the north to See Strasse or Muller Strasse in the south, and it will be carried under the Spree in the course of its route. It is proposed to provide 14 stations, and the total cost of construction is estimated at £2,850,000, which is to be raised by means of a municipal loan. It is expected that a period of four years would be required for the building and completion of the railway, the first being occupied in the removal of the network of underground sewers, pipes and mains. The question of extending the railway in the suburbs has already received attention, but this depends upon the attitude of the local authorities of Rixdorf, Schoneberg, and Wilmersdorf on the one hand, and that of those of Reinickendorf and Tegel on the other. It is suggested that the North-South line, as the railway is termed, should have a connection with the existing underground and elevated electric railway, and with the new extension of the line, as the time will come, it is said, when all means of transport in Berlin will be in the hands of the municipal authorities, and that there should, therefore, be a kind of central station provided where access to all the railways would be available.

The Cologne-Düsseldorf Project.—It would appear that there is now little prospect of the carrying out of the scheme for the construction of a high-speed electric railway between Cologne and Düsseldorf. About the middle of January the promoters of the line—the Allgemeine Elektricitäts Gesellschaft and the Siemens-Schuckert Works Co.—announced that the conditions submitted in the draft agreement by the towns of Düsseldorf and Cologne were not acceptable, and they, therefore, prepared a scheme of their own. While the negotiations on the proposed fresh agreement have been proceeding, it has become known that the conviction has gained the upper hand, especially in Government circles, that it is not in the interest of the State to grant such an important concession to a private company. The traffic between the two towns is so considerable that any concession to private enterprise would be, it is said, a great contravention of the principle of the State working of all important lines of communication.

THE DRAUGHTSMAN.

[COMMUNICATED.]

The occupation of an engineering draughtsman, instead of being one of the most interesting and desirable, has become a position to be avoided, as it is badly paid and is looked down upon with supreme contempt by every man who has been fortunate enough to obtain other employment on the staff of an engineering works, and who for that reason fancies himself a vastly superior person.

Do engineering employers as a body realise what an important element the draughtsman is in the machinery of the works? Do they recognise the fact that few of their employés have more power to waste or save their money and to injure or enhance their reputations? This is most serious for the reason that their influence for good or evil is more difficult to detect, than that, say, of the estimator or works manager. This influence is, of course, greater in the case of men who are originating designs or are engaged on work in which the firm has little experience. Where a certain machine has been made for years and the design by the survival of the fittest has arrived at approximate perfection, the power of the draughtsman is not so great, but to a certain extent it still exists. Before considering this subject further, it is advisable to define what is exactly meant by a "draughtsman." Is he merely a machine who draws and traces, more or less neatly, guided by a superior intelligence? Or is he a sentient being, who uses his brains and experience in evolving and improving the designs of his employers? Both these types are usually indiscriminately dubbed "draughtsman," sometimes differentiated by the prefix of "senior" or "leading" (although this is more often a distinction of age, and long service, than of ability).

The designation of "designer" would seem a more just title for the superior man. The designer should be an "engineer" in the true sense of the word; the ability to draw, that is, to express his own and the usually crude and vague ideas of others in the language of engineers, is merely the tool with which he works. He must have ideas first to express, and have a sound practical knowledge of the theory which underlies all mechanical construction. It is to him that technical education has the greatest value, although this alone is useless without the experience and ability to apply his science intelligently and in the right place. The lack of these last qualities has done much to discredit scientific methods in the eyes of the old style practical man, and they are the most difficult to acquire. An indispensable qualification is, of course, to have been through the shops. A man combining these qualities is by no means common, and is worth more than the maximum of £3 per week, which seems to be considered a sufficient salary for such. The danger is that the better class of draughtsman will become extinct; there is so little inducement to a well-educated, ambitious man to take up this branch of work. It is not only the inadequacy of his pay, but he gets no encouragement.

The credit for anything he may do is taken by others, frequently his inferiors in knowledge and experience, who sometimes overrule his better judgment, and then his is the blame for the result. This all tends to crush any enthusiasm the man may have, and generally he becomes resigned to jog along in a groove, with little or no interest in his work beyond that necessary to keep his job. Another fact which is perhaps even more fatal, and deters most men who desire to get on in the world from taking up drawing office work, is the extreme difficulty of obtaining any other position after long service at the board, and the seeming reluctance of employers to promote men from their drawing offices to any better post which becomes vacant. The prevalent idea is that a draughtsman, however clever, is good for nothing else (or is it that having a good man in that capacity they know how difficult he would be to replace?). It is for these reasons that draughtsmen are such "wandering Jews." It is usually found after a year or so with a firm that there is little prospect before a man, and therefore nothing to be gained by staying. And on receiving an offer of a few shilllings more a week and a change of work he migrates, carrying with him all the experience he has gained. This

cannot be to the advantage of employers generally, and it would seem a benefit to all if good men were encouraged.

Let employers treat "designers" as something more than mere drafting machines, give credit when due, make it clear that they have a chance of improving their positions. Then engineering draughtsmen would feel a pride in their work and a better and more competent class of men would be obtainable.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

5,289. "Improvements in apparatus for controlling and reversing the direction of rotation of electric motors adapted to directly drive machines, the direction of motion of which is periodically reversed, such as planing machines and the like." The Lancashire Dynamo and Motor Co., Ltd., A. P. Wood and G. E. Mason. March 5th.

5,300. "Improvements in magnetic clutches for conveying rotary motion." W. O. Hornsaill. March 5th.

5,303. "Improvements in or connected with means for the storage of electricity." A. Leisser. March 5th.

5,304. "Improvements relating to electric alarums." W. C. Hill. March 5th.

5,314. "Improvements in magnetic compasses for use on motor-boats and yachts." A. Hughes. March 5th.

5,325. "Improvements in electro-magnetic power generators." J. L. Potter. (Date applied for under Patents Act, 1901, April 3rd, 1905, being date of application in United States.) March 5th. (Complete.)

5,343. "Improvements in the regulating gear of electric arc lamps." J. Brockie. March 5th.

5,371. "Improvements in electro-magnets." F. W. Howorth. (J. W. Holman, United States.) March 5th. (Complete.)

5,373. "Improvements in telephone switches or cut-outs." W. H. R. Saunders and G. Sweetser. March 5th.

5,380. "Improvements in fittings for supporting electric lamps or other illuminants." J. Young. March 6th.

5,450. "Improvements in devices for the collection of current from direct-current dynamo-electric machines." M. Walker. March 6th.

5,465. "Improvements relating to brush-holders for electrical machines." Vickers, Sons & Maxim, Ltd., and G. H. Lindley. March 6th.

5,468. "Improvements relating to electrical illuminated discs for use for advertising or other purposes." A. B. Gregson. March 6th.

5,493. "Improvements in secondary batteries." L. Fiedler. March 6th. (Complete.)

5,508. "Improvements in machines for laying telegraph poles and the like." J. R. Brown. March 7th.

5,555. "Improvements in regulating mechanism for electric arc lamps." J. Brockie. March 7th.

5,573. "Improvements in and relating to electric motor control systems specially applicable to the operating means for bulk-head doors and the like." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) March 7th.

5,592. "Improved means for taking up the slack in the trolley ropes of electric tramcars and the like." J. Bowring and J. Whiteley. March 8th.

5,599. "Electrical automatic bolt." E. E. Daniel. March 8th.

5,602. "Improvements in dynamo-electric machinery." J. W. Burleigh. March 8th.

5,629. "Improvements in electric insulators." E. Goolding. March 8th.

5,652. "Improvements in common battery telephone systems." A. Ekstrom. (Date applied for under Patents Act, 1901, September 13th, 1905, being date of application in Germany.) March 8th. (Complete.)

5,656. "Improvements in and relating to secondary batteries." W. N. Caton and The X Electric Accumulator Co., Ltd. March 8th.

5,676. "Improvements in wall plugs and sockets for electric heating, power and lighting circuits." H. Bevis and A. J. D. Krause. March 9th.

5,685. "Apparatus combined in the form of a wall switch for regulating electric currents." J. A. Colquhoun. March 9th.

5,699. "Magneto ignition gear." A. F. White. March 9th.

5,744. "Improved method and means for working telegraphic installations composed of rapidly and slowly working lines." Siemens & Halske Akt.-Ges. (Date applied for under Patents Act, 1901, March 11th, 1905, being date of application in Germany.) March 9th. (Complete.)

5,811. "Improvements in electrically-propelled vehicle trolleys." J. A. Lamb. March 10th.

5,819. "Improvements in or relating to dynamos for maintaining constant potential at varying speeds." C. P. Elieson and F. Biliotti. March 10th.

5,833. "Improvements in and appertaining to combined electrolytic and suction palate plates for artificial teeth." C. F. Webb. March 10th.

5,853. "Improvements relating to the ventilation of dynamo-electric machines." E. M. Tingley. (Date applied for under Patents Act, 1901, March 17th, 1905, being date of application in United States.) March 10th. (Complete.)

5,855. "An improved method of recording on phonograph blanks by electricity." J. T. Thompson. March 10th.

5,856. "Improvements in or relating to electric arc lamps." B. M. Drake, A. D. Jones, P. V. Castell-Evans, and the Jandus Arc Lamp and Electric Co., Ltd. March 10th.

5,857. "Improvements in or relating to electrodes for electric arc lamps." B. M. Drake, A. D. Jones and the Jandus Arc Lamp and Electric Co., Ltd. March 10th.

5,893. "Improvements in and relating to high tension electric switches." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) March 10th.

5,894. "Improvements in the method of and apparatus for producing electricity." H. E. Fry. March 10th.

ELECTRICAL PATENTS EXPIRING IN 1906.

We are informed by W. P. Thompson & Co. that about 600 complete applications for electrical patents were filed in the year 1892. Only 37 of the patents granted on these applications have been maintained for their full term, viz., 14 years, and being of considerable value, we give short abstracts of them below:—

491. "Conduit for electric conductors." C. A. W. Hultmann, Sweden. January 9th, 1892. Conduits for electric conductors are formed as a collection of tubes in sectional blocks, each block having grooves in which iron bars are fitted, only one joint of any bar taking place in each section. The sections are connected by reduced ends, the groove, or channel, formed by the two ends being filled with bitumen surrounded by canvas.

4,017. "Electric meters." H. H. Lake. (E. Weston, U.S.) March 1st, 1892. Thermal current meters. In one form of construction a thin wire passes from a fixed stud and, after passing through notches in spring arms, is attached to a rotating arbor, provided with a pointer and a spring, which maintains the wire in a state of tension. When the circuit is completed through the wire and spring the wire lengthens and the pointer moves over a scale. In another form of construction a number of separate wires are used, the centre of each wire being connected mechanically to the end of the next wire; and the wires connected electrically end to end by means of springs; a strain being exerted on all the wires by a single spring, as before. When the current passes and the wire lengthens, the centre of each wire suffers a lateral displacement.

5,086. "Railway signalling." W. P. Hall, U.S.A. March 15th, 1892. Relates to an electric block system, in which a train entering a section short-circuits the normally closed rail current and makes the signal circuit, the signal then indicating "clear" if the two advance sections are clear, or, in the case of warning signals (which, when used, are alternate with the first or stop signals), if three advance sections are clear. Batteries work the rail circuits and relays with which they are connected. Other batteries work the signals through circuits which, by means of relays, are automatically broken or made by the trains, in short-circuiting the rail currents. Thus when a train enters a section and short-circuits the current, the relay is demagnetised, which allows the armature to drop and make the circuit of the signal, which, if two advance sections are free, indicates "clear." If on the other hand a train is in either of the next two sections, other relays are demagnetised, thus breaking the signal circuit, and keeping the signals at danger. On this principle the other sections are also worked. Warning signals may, if desired, be dispensed with. The signal may be audible, or it may be replaced by an interlocking device forming part of a larger system.

5,609. "Railway signals." W. R. Sykes, sen. March 22nd, 1892. Semaphores, controlling and operating. The rod connecting the semaphore arm to the balance lever is divided into two parts, the upper part carrying a casing containing the signal-controlling mechanism, into which casing the lower part is adapted to slide. This lower part is prevented from moving in the casing by a roller carried by an arm, which is held in a vertical position by a detent lever. An electro-magnet, by attracting its armature, tilts another lever and releases a pivoted hammer, which, by falling upon a pin connected to the detent lever, liberates the arm, and allows it to be pushed aside by the inclined end of the lower part of the rod. The electro-magnet is energised by the train operating a contact device, so that when the train passes over the contact device the arm will be pushed aside, and by allowing the two parts of the semaphore rod to approach each other, will cause the signal to move to "danger." The electro-magnet is connected to a treadle circuit by a projecting pin making contact with an insulated spring. In a modification of the signal-releasing device, the detent lever for releasing the arm is fixed at right angles to the armature, and in another modification, in which catches, &c., are dispensed with, the arm is held by the electro-magnet attracting the roller carried by the arm, which is released by a passing train breaking the circuit. Permanent magnets may be employed. By means of back-stroke locking the signalman is prevented from operating signals to the rear until he has replaced his lever for the signal that has been set to danger by a train. The invention is applicable to cases where one signal controls another on the same post, and may be used instead of the ordinary co-acting apparatus. Where a stop and a distant signal are on the same post, the two arms are connected by rods to the same balance lever, so that the two arms would work simultaneously, but an electric releasing device, the circuit of which is controlled from a distant cabin, is arranged in the rod attached to the distant signal arm. The invention is also applicable to any set of arms which apply to the same pair of metals, and where only one of the arms can be at "safety" at one time. The arms would be worked by the same signal lever and balance lever, but the circuits of the signal-controlling devices would be controlled by the point levers, so that only one of the signals would be lowered when the signal lever is operated.

6,253. "Electric railways." Lord A. S. Churchill. March 31st, 1892. Two conductors are used, and are connected each to one pole of the generator and to one of two series of plates or surfaces at a considerable distance apart. Two brushes are carried by the vehicles, and are of such length as to be always in contact with at least one of the plates. These plates are mounted on insulators, on posts inside or outside the rails, and the brushes are of wire.

6,707. "Electric meters, quantity." G. Kapp. April 7th, 1892. Relates to apparatus applicable for use where electricity is supplied from a central station, and it is desired to charge a smaller rate during some parts of the day so as to encourage the use of electricity for motive power, &c. Consists in providing each customer with a clock which will, at certain stated times, actuate mechanism to cause the meter to work at a slower rate, and at other times to return to the normal rate. In one form of construction a purely mechanical contrivance is employed. The clock is provided with a rotating 24-hour disk on which are adjustably secured two pallets. Loose on the shaft of the hour disk is a crank arm having a trigger which engages the end of a forked lever. A spiral spring connects the hour disk and the crank arm. The two pallets in their revolution engage a pin on the end of the lever, one of the pallets pulls the lever inwards and the other forces it outwards. In each case the trigger is released; in the first case from a nose, in the latter from a notched end. After each movement the crank flies over, in consequence of the spiral spring, to its opposite position; and this motion is conveyed by another spring to a crank on a spindle and thence to a third crank. This latter crank operates a clutch coupling, forming part of a differential gear. A shaft is driven by the meter, and on it are two wheels of different sizes, gearing with two other wheels, which are loose on the first or units shaft of the registering device. In this arrangement, according as one or other of the latter gearing wheels is held by the coupling, the rate of registering on the dials is less than the normal rate, or is the normal rate. In another arrangement, similar mechanism operates a mercury switch whereby a resistance is introduced into the circuit, and the meter registers less. In other modifications a relay is employed to operate the switch, either one or two meters being employed. In the former case a portion of the current is switched off at certain times, in the other the two meters are used alternately to register at different rates.

(To be continued.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Reciprocating Electric Engines. B. O. Wagner. (Date applied for under International Convention, September 22nd, 1904.) 19,092. September 21st.

Suspension of Rotating Apparatus and Magnetic Compasses. H. Anschütz-Kaempfe. (Date applied for under International Convention, March 25th, 1905.) 20,756. October 13th.

Electro-Magnetically Operated Heat Supply Valve for Heating and Ventilation. F. Kaeferle. (Date applied for under International Convention, July 17th, 1905.) 21,444. October 21st.

Indicators for Ships' Electric Signal and Similar Lamps. T. Harrison and A. S. Frazer. 22,741. November 16th.

Systems of Connections for Telephone Offices with Separated Plug Service, and Means for Signalling whether an Operator is Unoccupied or Engaged. Deutsche Telephonwerke R. Stock & Co., G.m.b.H. (Date applied for under International Convention, November 17th, 1904.) 23,722. November 17th.

Ignition Devices for Internal Combustion Apparatus. P. M. Justice. (Industrial Development Co.) 24,867. November 30th.